

SIGNAL SECTION ADVANCE NOTICE

ASSOCIATION OF AMERICAN RAILROADS

PUBLISHED BY THE SIGNAL SECTION, AAR, 59 EAST VAN BUREN STREET, CHICAGO 5, ILL.

Vol. LVI

No. 1

REPORTS

to be presented at the
Sixtieth Annual Meeting
WASHINGTON, D. C.
October 12, 13 and 14, 1959

RULES OF ORDER

RESULT OF 1958 LETTER BALLOT

PRINTED IN USA

CONTENTS

	Page
COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING	5
Economics of Electric Lighting of Switch Lamps.....	7
Use of "Off Track" Equipment by Railroad Signal Forces.....	9
Train Hour Value.....	10
Track and Roadway Maintenance Expenses Per Equated Track Mile.....	13
Economic Value of Car Retarders.....	16
Train Operation by Signal Indication Without Train Orders—Railroads in the United States.....	21
Economics of Centralized Traffic Control Involving Removal of One Main Track.....	22
Economics of Devices for Expediting Traffic in Yards.....	25
COMMITTEE II—CONTROLLED SIGNALING AND INTERLOCKINGS	27
Disposition of 1958 Letter Ballot Subjects.....	28
Specification 147-59—Car Retarder System.....	29
Methods of Installation of Track Circuit Connections to Facilitate the Use of Mechanized Track Maintenance Equipment.....	52
COMMITTEE III—SIGNAL SHOP PRACTICE	57
Relay Test Panel.....	58
Device for Checking Air Cylinder Efficiency.....	61
Shop Practices for Repair of Graphic Recording Instruments.....	62
Shop Practices for Repair of Electro-Pneumatic Switch Valves.....	65
Shop Practices for Repair of Switch Circuit Controller Shafts.....	68
Shop Practices for Repair of Switch Point Roller Bearings.....	70
COMMITTEE IV—AUTOMATIC BLOCK SIGNALING	72
Disposition of 1958 Letter Ballot Subjects.....	72
Requisites for Solderless Type Wire Terminals for Use in Wiring Signal Apparatus.....	74
COMMITTEE V—CONTRACTS AND INSTRUCTIONS	77
Disposition of 1958 Letter Ballot Subjects.....	77
Instructions for Locating Crosses and Grounds.....	78
Instructions for Track Circuits.....	82
COMMITTEE VI—DESIGNS	88
Disposition of 1958 Letter Ballot Subjects.....	89
Revised Drawings.....	91-99
Drawing to be Made Obsolete.....	100
New Drawings.....	100-107
Specifications for Bolts, Nuts and Threads.....	108
Specification 51-59—Incandescent Electric Lamps.....	109
Specification 155-59—Railroad-Highway Grade Crossing Signs.....	112
Specification 69-59—Signal Glasses (Exclusive of Kerosene Lantern Globes).....	121-137
COMMITTEE VII—MATERIALS RESEARCH	138
Disposition of 1958 Letter Ballot Subjects.....	139
Plastic Lenses, Roundels and Cover Glasses for Railroad Use.....	139
Specification 172-59—Air Depolarized Primary Cell (Renewable Type).....	140
Dry-Charged Storage Batteries for Use in Signal Service.....	146
Investigation into the Possible Use of Radioactive Materials for Lighting Signal and Switch Lamps.....	147
Nuclear Light Sources.....	150
Flexible Tips for Highway Crossing Gate Arms.....	150
Fiber Glass or Plastics for Use in Cable Risers or Junction Boxes.....	151
Vinyl Paint Systems as Compared to Conventional Paint Systems Now in Use.....	152

(Continued on inside back cover)

ASSOCIATION OF AMERICAN RAILROADS
SIGNAL SECTION

COMMITTEE REPORTS

1958 Fiscal Year

(September 18, 1958—October 14, 1959)

Sixtieth Annual Meeting

Statler Hilton

Washington, D. C.

October 12, 13 and 14, 1959

ASSOCIATION OF AMERICAN RAILROADS

OPERATIONS AND MAINTENANCE DEPARTMENT

ENGINEERING DIVISION

Signal Section

Office of the Secretary, 59 East Van Buren Street, Chicago 5, Ill.

R. G. MAY*
VICE-PRESIDENT
Operations and Maintenance
Department

Officers of Section
V. P. SHEPARDSON, Chairman
V. O. SMELTZER, First Vice-Chairman
R. C. STEELE, Second Vice-Chairman
R. H. C. BALLIET, Secretary

COMMITTEE OF DIRECTION

(January 1, 1959 to December 31, 1959)

Officers and Latest Past Chairman

V. P. Shepardson, Chairman, Richmond, Fredericksburg & Potomac R. R.
V. O. Smeltzer, First Vice-Chairman, Atchison, Topeka & Santa Fe Ry.
R. C. Steele, Second Vice-Chairman, Canadian Pacific Ry.
B. W. Molis, Denver & Rio Grande Western R. R. (Past Chairman)

Territorial Representatives

F. Youngwerth, Erie R. R. (East)
H. C. Stratton, Union Pacific R. R. (West)
R. E. Testerman, St. Louis-San Francisco Ry. (West)
E. B. Walkup, New York, New Haven & Hartford R. R. (New England)
W. W. Beard, Baltimore & Ohio R. R. (East)
J. R. DePriest, Seaboard Air Line R. R. (South)
G. B. Blatt, Reading Co. (East)
C. T. Marak, Missouri Pacific R. R. (West)

* Deceased June 2, 1959.

ORGANIZATION

Standing Committees

- I. ECONOMICS OF RAILWAY SIGNALING.
J. A. Moore, New York Central R. R., Chairman.
- II. CONTROLLED SIGNALING AND INTERLOCKINGS.
R. W. Troth, St. Louis-San Francisco Ry., Chairman.
- III. SIGNAL SHOP PRACTICE.
J. P. Stevely, New York Central R. R., Chairman.
- IV. AUTOMATIC BLOCK SIGNALING.
F. L. Chatten, Pennsylvania R. R., Chairman.
- V. CONTRACTS AND INSTRUCTIONS.
F. Youngwerth, Erie R. R., Chairman.
- VI. DESIGNS.
C. J. R. Taylor, Erie R. R., Chairman.
- VII. MATERIALS RESEARCH.
T. T. Hart, New York Central R. R., Chairman.
- VIII. HIGHWAY GRADE CROSSING PROTECTION.
P. H. Foley, Chicago, Burlington & Quincy R. R., Chairman.
- IX. WIRE AND CABLE.
V. O. Smeltzer, Atchison, Topeka & Santa Fe Ry., Chairman.
- X. SIGNALING PRACTICE.
J. R. DePriest, Seaboard Air Line R. R., Chairman.
- XI. ELECTRONICS.
J. M. Hesser, Norfolk & Western Ry., Chairman.
- XII. CIRCUIT DESIGN.
T. L. Carlson, Chesapeake & Ohio Ry. System, Chairman.

COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING

Personnel

J. A. Moore, Chairman

G. B. Blatt, Vice-Chairman

M. F. Anderson

H. R. Beck

H. A. Hudson

R. A. Johnson

K. M. Lockerby

B. W. Molis

A. E. Parnell

G. Pipas

H. C. Stratton

J. S. Webb

B. J. Worley

S. W. Freeman*

C. A. James*

H. F. Kusick*

C. B. Mattingly*

C. W. Sooby*

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Report on the economics of railway signaling:
 - Economics of controlled switch heaters and snow blowers.
 - Economics of "off track" equipment.
 - Economics of signaling light traffic single-track lines.
 - Economics of automatic, auto-manual, and manual-controlled highway crossing protection devices.
 - Economic value of car retarders.
 - Economics of CTC involving removal of one or more main tracks in multiple-track territory.
 - Economics of devices for expediting traffic in yards.
 - Study and report upon a "train hour value."
 - Report on track and roadway maintenance expense per equated track mile.
 - Operating advantages of CTC installations.
 - Economics of standardization of signal equipment.
 - Economics of relocating and consolidating traffic control machines.
 - Economics of electric lighting of switch lamps.
 - Train operation by signal indication.

* Consulting member.

The committee submits for consideration, reports on the following subjects*:

3. Economics of electric lighting of switch lamps.

Use of "off track" equipment by railroad signal forces.

Train hour value.

Track and roadway maintenance expenses per equated track mile.

Economic value of car retarders.

Economics of centralized traffic control involving removal of one main track.

Economics of devices for expediting traffic in yards.

Train operation by signal indication without train orders—railroads of the United States.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

ECONOMICS OF ELECTRIC LIGHTING OF SWITCH LAMPS*

Missouri Pacific R.R.

During recent years, the Missouri Pacific R.R. has replaced a number of outlying oil-lighted switch lamps with electric lamps powered by carbon type batteries. The net saving per annum has been sufficient to pay for the capital investment in less than 2 years.

In addition to fiscal benefits, the following advantages to operation resulted:

1. Greater lamp visibility achieved.
2. More uniform lamp aspects obtained.
3. Outages from high winds eliminated.
4. Outages from vibration reduced.
5. Substantial man hours released for more productive work.

Economic Statement

1. Cost of Installation (per switch lamp):	
(a) Capital Investment.....	<u>\$70</u>
2. Gross Saving per Annum.....	\$85
3. Increased Annual Operating Expenses.....	<u>41</u>
4. Net Reduction in Annual Operating Expenses.....	\$44
5. Deduction for Interest Charges @ 4% (of 1-a).....	<u>3</u>
6. Net Saving per Annum.....	<u>\$41</u>
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	58.6%

Louisville & Nashville R.R.

The Louisville & Nashville R.R. has replaced 163 oil-lighted switch lamps with electric-lighted switch lamps, 42 of which are powered by alternating current and 121 by batteries.

In addition to fiscal benefits, the following advantages to operation resulted:

1. Greater lamp visibility achieved.
2. More uniform lamp aspects obtained.
3. Outages from high winds eliminated.
4. Substantial man hours released for more productive work.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 8-A and 308-A.

Economic Statement

1. Cost of Installation (163 lamps):		
(a) Capital Investment.....	\$6,002	
(b) Operating Expenses.....	1,093	
(c) Total.....		<u>\$7,095</u>
2. Gross Saving per Annum.....		\$7,232
3. Increased Annual Operating Expenses.....		<u>4,234</u>
4. Net Reduction in Annual Operating Expenses.....		\$2,998
5. Deduction for Interest Charges @ $4\frac{1}{2}\%$ (of 1-a).....		<u>270</u>
6. Net Saving per Annum.....		<u>\$2,728</u>
7. Annual Return over $4\frac{1}{2}\%$ Interest:		
(a) On Capital Investment ($6 \div 1-a$).....	45.5%	
(b) On Total Cost ($6 \div 1-c$).....	38.4%	

Action Recommended

Acceptance as information.

USE OF "OFF TRACK" EQUIPMENT BY
RAILROAD SIGNAL FORCES*

In connection with a centralized traffic control installation in 1956, a south-eastern railroad reports the use of "off track" equipment in installing an underground code circuit for a distance of 148 miles.

Prior to the centralized traffic control installation, a 4.4 kilovolt, three-phase power transmission line was in service throughout the entire territory. To eliminate the maintenance of this pole line as well as the expense of keeping brush and trees clear of the line and to minimize the interference from ice storms and lightning damage, it was decided to remove the line and secure electric power locally. The use of existing communications pole line for signal purposes was decided against because of the expense of upgrading and the possibility of its being superseded by micro-wave for communications. Coded track circuits were used, which eliminated the need for signal control on line. At some crossing signal locations, it was necessary to provide coded line repeaters around the conventional non-coded direct current approach track circuits. These circuits were installed underground in the same trench with the centralized traffic control code circuit. Also, at certain locations, power and control circuits were placed in the same trench.

The trench was generally near the edge of the roadbed a few feet outside of the ballast line and usually 30 inches deep. The trenching was largely in clay with some rock being occasionally encountered. Underground construction for the code line was usually continued through towns to secure the added advantage of eliminating service interruptions from fires adjacent to an open pole line. Self-propelled, power-operated trenchers of the crawler type were used to dig the trench. Cable was received in 5,000-foot lengths and distributed by means of trailer-type reels equipped with rubber tires and air brakes for handling on highways with trucks. A small bulldozer with a hydraulically operated blade in front was used to backfill the trench and level the ground behind the trenchers.

Two trenching machines were used on the project and each unit averaged about $\frac{1}{4}$ mile per day. The maximum amount of cable installed in one day with both machines amounted to 6,300 feet.

The average cost per mile of installing the underground cable, excluding cable and other materials, was as follows:

Labor for trenching, laying cable and backfill.....	\$610
Fuel and machine repairs.....	52
Interest and depreciation on equipment.....	33
Total cost per mile.....	\$695

Action Recommended

Acceptance as information.

* Previous report on this subject appears in AAR Signal Section 1955 Proceedings, Vol. LIII, pp. 12-A and 241-A.

TRAIN HOUR VALUE

At the 1958 Annual Meeting* the committee submitted a report and presented Table II for the calendar year 1956. A revision of Table II for the calendar year 1957 is herein presented. As shown, total train hour cost (excluding train crew wages) for the year 1957 varied from a minimum of \$21.04 to a maximum of \$86.55 with a composite average of \$43.51 for the 73 railroads.

TABLE II
Specified Elements of Train Hour Cost
per Road Freight Train Hour—Year 1957
(Excluding road freight train crews' wages)

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense a	Total train hour cost (excluding train crew wages)
1	2	3	4	5= 2+3+4
Item number**	Items 2 to 8	Item 9	Item 11	Items 2 to 11
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	\$24.75	\$4.38	\$0.41	\$29.54
2 Boston & Maine.....	27.44	4.45	0.63	32.52
3 Central Vermont.....	20.63	0.07	0.34	21.04
4 Maine Central.....	24.95	4.04	0.65	29.64
5 New York, New Haven & Hartford.....	41.12	5.41	0.91	47.44
6 Rutland.....	18.96	3.33	0.51	22.80
GREAT LAKES REGION:				
7 Ann Arbor.....	26.41	4.68	0.59	31.68
8 Delaware & Hudson.....	42.16	6.97	0.86	49.99
9 Delaware, Lackawanna & Western.....	36.79	5.52	0.62	42.93
10 Erie.....	39.52	5.58	0.82	45.92
11 Grand Trunk Western.....	45.07	0.75	0.84	46.66
12 Lehigh & New England.....	19.90	8.26	0.38	28.54
13 Lehigh Valley.....	44.83	5.14	0.78	50.75
14 Monongahela.....	26.67	3.69	0.63	30.99
15 New York Central.....	35.85	3.95	0.70	40.50
16 New York, Chicago & St. Louis.....	41.50	3.21	0.83	45.54
17 Pittsburgh & Lake Erie.....	47.86	3.16	0.60	51.62
18 Wabash.....	35.13	5.66	0.56	41.35
CENTRAL EASTERN REGION:				
19 Baltimore & Ohio.....	39.30	1.84	0.88	42.02
20 Bessemer & Lake Erie.....	78.00	12.92	1.36	92.28
21 Cent.R.R. of New Jersey (Incl. C.R.R. of Pa.).....	39.25	5.11	0.95	45.31
22 Chicago & Eastern Illinois.....	35.90	4.45	0.63	40.98
23 Detroit, Toledo & Ironton.....	24.32	4.22	0.32	28.86

a Payroll taxes calculated at rate 6.37 per cent. Reduction from actual rate of 8.25 per cent account compensation in excess of \$350 per month.

* AAR Signal Section 1957 Proceedings, Vol. LV, pp. 11-A and 308-A.

** See Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices, p. 20.

TABLE II—Continued

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense ^a	Total train hour cost (excluding train crew wages)
1	2	3	4	5 = 2+3+4
Item number*	Items 2 to 8	Item 9	Item 11	Items 2 to 11
CENTRAL EASTERN REGION—Con.:				
24 Elgin, Joliet & Eastern.....	\$32.20	\$2.82	\$0.92	\$35.94
25 Illinois Terminal.....	25.68	2.12	0.47	28.27
26 Long Island.....	21.43	2.04	0.53	24.00
27 Monon.....	37.40	4.32	0.79	42.51
28 Pennsylvania.....	38.07	4.15	0.80	43.02
29 Reading.....	31.17	5.76	0.70	37.63
30 Western Maryland.....	42.52	4.38	0.96	47.86
POCAHONTAS REGION:				
31 Chesapeake & Ohio.....	37.35	6.23	0.62	44.20
32 Norfolk & Western.....	63.12	4.13	1.32	68.57
33 Richmond, Fred'burg & Potomac.....	50.68	6.40	0.92	58.00
34 Virginian.....	27.02	5.14	0.51	32.67
SOUTHERN REGION:				
35 Alabama Great Southern.....	47.30	11.43	1.07	59.80
36 Atlantic Coast Line.....	32.59	5.27	0.68	38.54
37 Central of Georgia.....	32.19	4.82	0.64	37.65
38 Cincinnati, New Orleans & Tex. Pac.....	50.41	17.75	1.11	69.27
39 Clinchfield.....	50.31	9.18	1.09	60.58
40 Florida East Coast.....	26.53	4.82	0.55	31.90
41 Gulf, Mobile & Ohio.....	48.85	5.86	1.30	56.01
42 Illinois Central.....	30.90	2.70	0.50	34.10
43 Louisville & Nashville.....	35.21	7.16	0.67	43.04
44 Norfolk Southern.....	23.53	3.52	0.59	27.64
45 Seaboard Air Line.....	38.34	6.44	0.87	45.65
46 Southern.....	27.23	6.60	0.60	34.43
NORTHWESTERN REGION:				
47 Chicago & North Western.....	24.09	5.91	0.39	30.39
48 Chicago Great Western.....	30.53	7.86	0.63	39.02
49 Chicago, Milwaukee, St. Paul & Pac.....	36.52	3.73	0.69	40.94
50 Duluth, Missabe & Iron Range.....	80.00	4.67	1.88	86.55
51 Great Northern.....	33.59	3.24	0.71	37.54
52 Minneapolis & St. Louis.....	28.02	4.70	0.62	33.34
53 Mpls., St. Paul & Sault Ste. Marie (Incl. Wis. C.).....	30.41	4.42	0.62	35.45
54 Northern Pacific.....	38.71	4.28	0.68	43.67
55 Spokane, Portland & Seattle.....	23.04	3.87	0.50	27.41
CENTRAL WESTERN REGION:				
56 Atchison, Topeka & Santa Fe Sys.....	40.01	4.88	0.81	45.70
57 Chicago, Burlington & Quincy.....	31.47	4.22	0.51	36.20
58 Chicago, Rock Island & Pacific.....	27.78	2.96	0.54	31.28
59 Colorado & Southern.....	28.97	6.74	0.55	36.26
60 Denver & Rio Grande Western.....	40.48	5.38	0.74	46.60

^a Payroll taxes calculated at rate 6.37 per cent. Reduction from actual rate of 8.25 per cent account compensation in excess of \$350 per month.

* See Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices, p. 20.

TABLE II—Continued

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense a	Total train hour cost (excluding train crew wages)
1	2	3	4	5 = 2+3+4
Item number*	Items 2 to 8	Item 9	Item 11	Items 2 to 11
CENTRAL WESTERN REGION—Con.:				
61 Fort Worth & Denver.....	\$25.75	\$3.85	\$0.45	\$30.05
62 Northwestern Pacific.....	22.11	—	0.62	22.73
63 Southern Pacific.....	46.28	7.05	1.07	54.40
64 Union Pacific.....	60.75	7.20	1.37	69.32
65 Western Pacific.....	44.50	5.07	0.81	50.38
SOUTHWESTERN REGION:				
66 Kansas City Southern.....	44.44	5.51	0.84	50.79
67 Louisiana & Arkansas.....	35.08	5.71	0.63	41.42
68 Missouri-Kansas-Texas.....	31.25	2.90	0.70	34.85
69 Missouri Pacific.....	38.06	6.23	0.84	45.13
70 Frisco Lines.....	35.52	5.66	0.68	41.86
71 St. Louis Southwestern.....	34.40	3.55	0.73	38.68
72 Texas & New Orleans.....	33.73	1.87	0.61	36.21
73 Texas & Pacific.....	37.87	7.66	0.61	46.14
Composite Average.....	37.91	4.83	0.77	43.51
AVERAGES BY REGIONS:				
New England.....	30.67	4.33	0.68	35.68
Great Lakes.....	37.86	4.29	0.73	42.88
Central Eastern.....	37.80	3.62	0.82	42.24
Pocahontas.....	44.61	5.48	0.83	50.92
Southern.....	33.69	5.77	0.69	40.15
Northwestern.....	33.25	4.38	0.64	38.27
Central Western.....	42.97	5.55	0.91	49.43
Southwestern.....	36.11	4.91	0.73	41.75

a Payroll taxes calculated at rate 6.37 per cent. Reduction from actual rate of 8.25 per cent account compensation in excess of \$350 per month.

Action Recommended

Acceptance as information.

* See Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices, p. 20.

TRACK AND ROADWAY MAINTENANCE EXPENSES PER EQUATED TRACK MILE

At the 1958 Annual Meeting* the committee submitted Table I for the calendar year 1956. A revision of Table I for the calendar year 1957 is herein presented. As shown, track and roadway maintenance expenses per equated track mile for the year 1957 varied from a minimum of \$1,444 to a maximum of \$8,136 with a composite average of \$2,918 for the 73 railroads. This data is developed from ICC Annual Report Form A of each railroad.

TABLE I
Track and Roadway Maintenance Expenses per Equated
Track Mile (Running Tracks) and Traffic Density
Calendar Year 1957

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	644	\$2,045,701	\$3,177	2,943
2 Boston & Maine.....	2,052	5,018,701	2,446	6,297
3 Central Vermont.....	351	1,843,683	5,253	4,379
4 Maine Central.....	1,006	3,133,917	3,115	3,174
5 New York, New Haven & Hartford.....	2,358	7,108,307	3,015	9,232
6 Rutland.....	345	587,133	1,702	1,609
GREAT LAKES REGION:				
7 Ann Arbor.....	321	693,801	2,161	4,562
8 Delaware & Hudson.....	949	3,536,908	3,727	11,651
9 Delaware, Lackawanna & Western.....	1,453	4,521,749	3,112	13,600
10 Erie.....	3,129	10,124,588	3,236	12,688
11 Grand Trunk Western.....	1,218	3,759,512	3,087	8,730
12 Lehigh & New England.....	175	468,230	2,676	3,082
13 Lehigh Valley.....	1,599	4,094,316	2,561	8,665
14 Monongahela.....	205	369,737	1,804	4,590
15 New York Central.....	13,985	40,236,041	2,877	10,750
16 New York, Chicago & St. Louis.....	2,606	10,333,955	3,965	13,241
17 Pittsburgh & Lake Erie.....	342	2,594,482	7,586	14,256
18 Wabash.....	2,460	6,248,495	2,540	9,301

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to operating expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272 and 274.

c Represents equivalent expense for 1 mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

* AAR Signal Section 1957 Proceedings, Vol. LV, pp. 14-A and 309-A.

TABLE I—Continued

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
CENTRAL EASTERN REGION:				
19 Baltimore & Ohio.....	7,595	\$28,357,359	\$3,734	12,760
20 Bessemer & Lake Erie.....	244	1,305,141	5,349	16,814
21 Cent. R.R. of New Jersey (Incl. C.R.R. of Pa.)	793	2,976,694	3,754	9,290
22 Chicago & Eastern Illinois.....	935	2,015,326	2,155	6,966
23 Detroit, Toledo & Ironton.....	468	1,674,433	3,578	4,552
24 Elgin, Joliet & Eastern.....	277	951,690	3,436	11,602
25 Illinois Terminal.....	376	858,624	2,284	2,777
26 Long Island.....	540	3,530,764	6,538	8,729
27 Monon.....	569	1,496,885	2,631	5,428
28 Pennsylvania.....	13,949	49,639,478	3,559	15,154
29 Reading.....	2,080	7,340,179	3,529	12,101
30 Western Maryland.....	860	3,913,094	4,550	9,293
POCAHONTAS REGION:				
31 Chesapeake & Ohio.....	5,755	23,794,806	4,135	16,122
32 Norfolk & Western.....	2,956	17,016,598	5,757	24,065
33 Richmond, Fred'burg & Potomac.....	235	1,484,393	6,317	33,380
34 Virginian.....	715	4,046,835	5,660	18,698
SOUTHERN REGION:				
35 Alabama Great Southern.....	382	1,760,864	4,610	11,105
36 Atlantic Coast Line.....	6,131	13,301,275	2,170	6,077
37 Central of Georgia.....	1,861	4,012,499	2,156	4,701
38 Cincinnati, New Orleans & Tex. Pac.....	491	3,994,761	8,136	23,240
39 Clinchfield.....	325	2,396,320	7,373	15,352
40 Florida East Coast.....	949	3,269,641	3,445	10,189
41 Gulf, Mobile & Ohio.....	2,982	8,223,847	2,758	5,606
42 Illinois Central.....	7,792	24,589,600	3,156	8,090
43 Louisville & Nashville.....	6,639	21,064,748	3,173	7,771
44 Norfolk Southern.....	657	1,891,202	2,879	2,521
45 Seaboard Air Line.....	4,616	12,537,780	2,716	7,417
46 Southern.....	6,895	18,636,843	2,703	6,762
NORTHWESTERN REGION:				
47 Chicago & North Western.....	10,545	21,224,599	2,013	3,937
48 Chicago Great Western.....	1,477	3,166,238	2,144	5,014
49 Chicago, Milwaukee, St. Paul & Pac.....	11,194	19,307,678	1,725	4,246
50 Duluth, Missabe & Iron Range.....	722	2,064,862	2,860	11,184
51 Great Northern.....	8,761	29,783,078	3,400	5,846
52 Minneapolis & St. Paul.....	1,346	1,942,984	1,444	2,598
53 Mpls., St. Paul & Sault Ste. Marie (Incl. Wis. C.)	4,357	10,093,039	2,317	3,643
54 Northern Pacific.....	7,634	15,587,061	2,042	5,176
55 Spokane, Portland & Seattle.....	964	3,244,686	3,366	6,117
CENTRAL WESTERN REGION:				
56 Atchison, Topeka & Santa Fe Sys.....	15,915	49,100,002	3,085	9,988
57 Chicago, Burlington & Quincy.....	9,585	20,230,996	2,111	5,934
58 Chicago, Rock Island & Pacific.....	8,113	16,676,830	2,056	5,644
59 Colorado & Southern.....	629	1,097,871	1,745	4,400
60 Denver & Rio Grande Western.....	2,407	5,785,042	2,403	7,418

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to operating expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 266, 270, 271, 272 and 274.

c Represents equivalent expense for 1 mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

TABLE I—Continued

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) c (000)
		Total b	Per equated track mile c	
CENTRAL WESTERN REGION—Con.:				
61 Fort Worth & Denver.....	1,316	\$2,983,098	\$2,267	3,144
62 Northwestern Pacific.....	367	1,789,822	4,877	4,826
63 Southern Pacific.....	9,412	36,127,484	3,838	12,568
64 Union Pacific.....	11,629	37,453,471	3,221	11,365
65 Western Pacific.....	1,266	5,047,262	3,987	8,922
SOUTHWESTERN REGION:				
66 Kansas City Southern.....	1,010	1,919,293	1,900	9,595
67 Louisiana & Arkansas.....	692	1,769,643	2,557	5,814
68 Missouri-Kansas-Texas.....	3,107	6,594,020	2,122	4,319
69 Missouri Pacific.....	10,199	26,642,957	2,612	5,905
70 Frisco Lines.....	5,210	10,025,027	1,924	5,369
71 St. Louis Southwestern.....	1,461	4,647,751	3,181	8,171
72 Texas & New Orleans.....	4,482	13,625,380	3,040	6,436
73 Texas & Pacific.....	2,043	6,274,483	3,071	8,872
Composite Average.....	249,108	727,005,302	2,918	8,320
AVERAGES BY REGIONS:				
New England.....	6,757	19,737,442	2,921	5,879
Great Lakes.....	28,442	86,981,814	3,058	10,846
Central Eastern.....	28,687	104,059,667	3,627	12,801
Poconantas.....	9,662	46,342,632	4,796	15,691
Southern.....	39,717	115,679,380	2,913	7,211
Northwestern.....	47,000	106,414,135	2,264	4,676
Central Western.....	60,638	176,291,678	2,907	8,933
Southwestern.....	28,205	71,498,554	2,535	6,169

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to operating expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272 and 274.

c Represents equivalent expense for 1 mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

Action Recommended

Acceptance as information.

ECONOMIC VALUE OF CAR RETARDERS*

Chicago, Milwaukee, St. Paul & Pacific R.R.

The Chicago, Milwaukee, St. Paul & Pacific R.R. completed modernization and enlargement of yard at St. Paul, Minn., on August 20, 1956. This yard which was formerly operated as a flat yard was converted to gravity switching, and includes such related improvements as semi-automatic or push button retardation, automatic switching, shove signals and cab hump signals.

From St. Paul Yard as a hub, four main routes radiate: (1) west to the Dakotas and Pacific Coast; (2) north to Duluth, Minn.; (3) south to Austin, Minn. and midwest points; and, (4) south and east to Milwaukee, Wis., Chicago, Ill. and connecting points.

The average number of road trains received at St. Paul each day is eight and road train departures, eight. In addition, an average of 12 industry and interchange yard drags are received each day.

The yard consists of 35 classification tracks, 10 receiving and departure tracks and 12 miscellaneous local, car cleaning, repair and icing tracks. The combined standing capacity is 3,509 cars. There are 170 single turnouts, 38 of which are power-operated, 2 power-operated lapped turnouts and 2 mechanical interlocked switches.

Communication equipment includes 18 paging speakers, 66 talk-back speakers, 5,300 feet of 4-inch pneumatic tube, tape recorders and radio.

There are 54 floodlights on 8 towers, also a total of 54 side lights on wood poles at the approach to the hump and at each lead on each side of the yard.

Economic comparison for the months of March, April, May and June 1956 with a like 4-month period in 1957 discloses:

1. Reduction in yard engine assignments and related personnel.
2. Decrease in terminal delay payment.
3. Reduction in overtime payments for yard switching.
4. Reduction in car cleaning costs.
5. Per diem savings.
6. Increase in expense, account of additional signal maintainers, communication equipment maintainers, retarder operators and skatemen.

* Previous report on this subject appears in AAR Signal Section 1956 Proceedings, Vol. LIV, pp. 15 and 228.

Economic Statement

1. Cost of Installation:		
(a) Capital Investment.....	\$3,858,486	
(b) Operating Expenses.....	1,126,240	
(c) Total.....		\$4,984,726
2. Gross Saving per Annum (Estimated).....		
		\$ 683,132
3. Increased Annual Operating Expenses.....		
		57,389
4. Net Reduction in Annual Operating Expenses.....		
		\$ 625,743
5. Deduction for Interest Charges @ 4% (of 1-a).....		
		154,339
6. Net Saving per Annum.....		
		\$ 471,404
7. Annual Return over 4% Interest:		
(a) On Capital Investment ($6 \div 1-a$).....		12.2%
(b) On Total Cost ($6 \div 1-c$).....		9.5%

St. Louis-San Francisco Ry.

The St. Louis-San Francisco Ry. recently completed the installation of a modern classification yard at Memphis, Tenn., known as Tennessee Yard.

Incorporated into this yard are many of the latest developments in car classification, including automatic switching and automatic retarder control equipment. Several modern communication systems have been utilized, including talk-back and paging speakers, radio, dial telephones and pneumatic tubes.

Memphis was chosen as a location for this yard because of its strategic location on the Frisco system. Frisco lines at Memphis run southeast to Birmingham, Ala., Pensacola, Fla. and Mobile, Ala.; north to St. Louis, Mo.; northwest to Springfield and Kansas City, Mo.; west to Wichita and Ellsworth, Kans.; and southwest to Tulsa, Okla., Oklahoma City, Okla., Ft. Worth, Dallas and Quanah, Tex.

Previous switching in this area had been done in an old flat switching yard near downtown Memphis which was inadequate. The new yard is located south of the city on land adjacent to the main line where it was possible to build an entirely new facility.

The blocking done at this new yard has considerably reduced switching at other Frisco yards. In addition to Memphis, cars are blocked for individual industries at various other yards and terminals.

One of the innovations in this yard is a track occupancy panel on the wall over the desk of the yardmaster. Indication lamps on the panel are arranged to show the occupancy of either half of each of the eight receiving-departure yard tracks and thoroughfare track. With this device, the yardmaster can route an incoming train quickly and easily into an empty track.

Radio is provided for the yard and, in addition, cab signals for hump engines. Other facilities at Tennessee Yard are car repair yard, cleaning tracks, diesel servicing facilities and icing facilities.

Economic Statement

1. Cost of Installation:	
(a) Capital Investment.....	\$10,098,572
(b) Operating Expenses.....	—
(c) Total.....	<u>\$10,098,572</u>
2. Gross Saving per Annum.....	\$ 1,233,700
3. Increased Annual Operating Expenses.....	286,700
4. Net Reduction in Annual Operating Expenses.....	\$ 947,000
5. Deduction for Interest Charges @ 4% (of 1-a).....	403,943
6. Net Saving per Annum.....	<u>\$ 543,057</u>
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	5.4%
(b) On Total Cost ($6 \div 1-c$).....	5.4%

New York Central System

On March 14, 1957, the New York Central System officially dedicated its new electronically controlled (automatic) retarder classification yard at Buffalo, N. Y., known as Frontier Yard. This facility is strategically located on the eastern edge of Buffalo adjacent to the New York-Chicago main line. The new yard simplifies operations in this area which was formerly served by seven small yards bunched along the main line just east of the Central passenger terminal and by the larger Gardenville Yard located on its own two-track Gardenville branch. The yard is equipped with devices for reporting car speeds, weight, track destinations, weather conditions and other factors. These data are fed into an analog computer which computes the rollability of each car and then automatically adjusts the retarders so that the cars will couple at just the right speed.

Traffic is unusually heavy. On an average day 67 freight trains move into and out of this area. In this territory freight service is supplied to 240 principal industries. In addition, connection is made with 8 other railroads. Supplementing the heavy freight traffic, the main line tracks which serve Frontier Yard also handle 72 passenger trains that move daily into and out of the Buffalo terminal.

The classification yard consists of 63 tracks with a varying capacity of 30 to 120 cars each and a total of 3,110 cars. This yard is equipped with one master retarder and seven group retarders, all controlled electronically from the retarder tower. Yard facilities were arranged to provide three receiving and departure yards. The north yard consists of eight tracks of varying capacity of 70 to 150 cars each and a total of 1,000 cars; the south yard consists of 12 tracks with a varying capacity of 50 to 150 cars each and a total of 1,080 cars; and the east receiving and departure yard contains seven tracks with a capacity of 70 to 150 cars each and a total of 680 cars. Supporting the yard are five tracks with a capacity of 85 cars for making repairs to freight cars, 3 tracks for servicing diesel freight locomotives, as well as 3 car cleaning tracks with a

capacity for 240 cars, important in reconditioning grain cars at this big milling center. The yard contains 12 miles of miscellaneous lead, crossover, thoroughfare and special service tracks. There are 135 single power-operated switches; 71 are of the "electric switchman" type.

Communication equipment includes 8 paging speakers, 135 talk-back speakers and 10,450 feet of 4-inch pneumatic tube. Disc recorders, teletype and radio complete the communications network. There are 72 floodlights, rated at 35,534,000 candlepower, on 7 floodlight towers.

The economic benefits derived include the following:

1. Reduction in car detentions and improvement of service to shippers.
2. Reduction in equipment and lading damage due to installation of automatic switching and retarding controls, and elimination of rehandling of cars.
3. Per diem savings.
4. Reduction in yard engine assignments and personnel.
5. Modern consolidated switching facilities reduce switching requirements at other yards.

New York Central System

Robert R. Young Yard, located at Elkhart, Ind., about 100 miles east of Chicago, Ill. on the main line of the New York Central System to Toledo, Ohio and New York, N. Y., marks the consolidation of three flat switching yards located at Niles, Mich., with nine flat switching yards at Elkhart. The combined operation was converted into a gravity switching yard with its attendant improvements, including a new system for the automatic control of retarders and a new programmed switching system.

The new yard, as shown on folded sheet following page 20, is about 4 miles long. It lies parallel to and south of the main line, a mile west of Elkhart passenger station. It will be the center of freight car classification activities for the western end of the railroad. It is an in-line type hump yard with the receiving yard at the east, followed by the classification yard and with parallel departure yards.

There are 15 tracks in the receiving yard with a total capacity of approximately 2,000 cars. A running track in the eastward departure yard as well as an Early Bird track is used for trains which only have blocks of cars added or taken off at Elkhart. An 11-track local yard has varying capacity of 27 to 50 cars. The classification yard consists of eight groups of nine tracks each, with capacities varying from 32 to 70 cars. The total capacity of the classification tracks is approximately 3,600 cars. Other facilities include a 200-car capacity repair area. Engine service facilities of eight tracks are located at a strategic point north of and adjacent to the east end of the classification yard. There are two car cleaning tracks with a total capacity of 95 cars along the south side of the classification yard for cleaning and up grading cars, including stock cars. There are 375 single turnouts, 142 of which are power-operated.

Adequate communication is furnished throughout the new yard by 145 talk-back speakers, 35 paging speakers, yard radios and telephones; 15,100 feet of 6-inch pneumatic tube are used to connect the general yard office, the hump office and west yard office. Two television cameras, one at each end of the yard, are focused to pick up the car numbers of arriving freight trains. A yard clerk reads the train's consist to a dictograph. The completed list is sent by

pneumatic tube for use in the classification procedure. Teletype, disc recorders, walkie-talkies and radio completes the communication network.

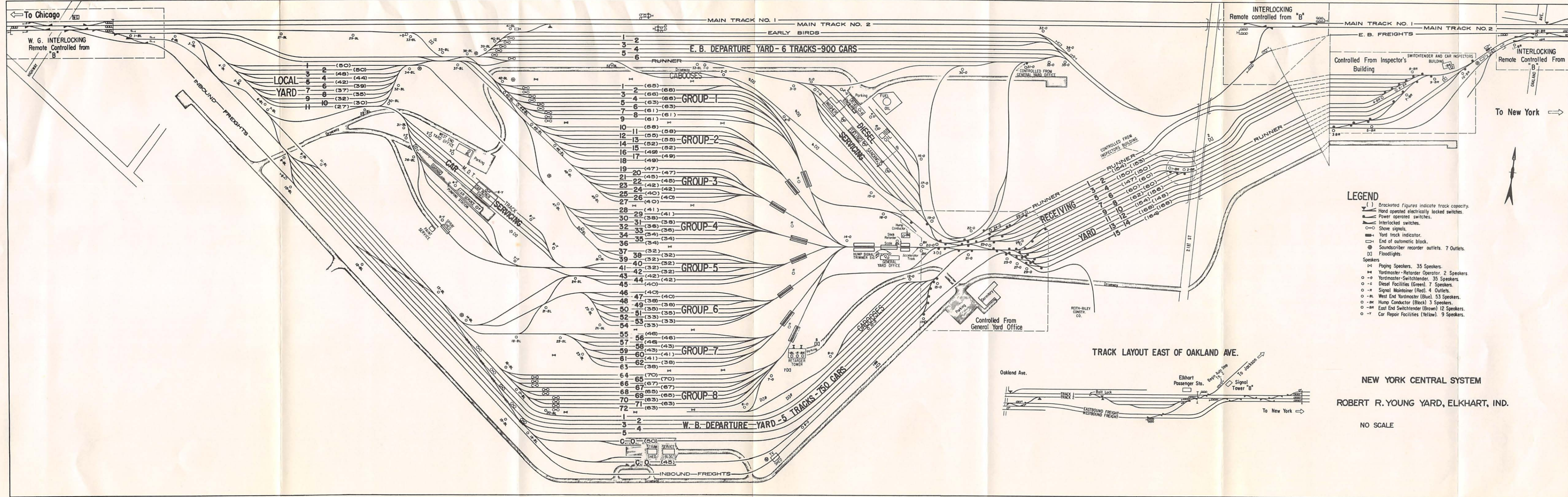
There are 126 floodlight units, rated at 67,000,000 candlepower, mounted on 12 floodlight towers.

The economic benefits derived include the following:

1. Reduction in car detentions and improvement of service to shippers.
2. Reduction in equipment and lading damage.
3. Per diem savings.
4. Reduction in yard engine assignments.
5. Modern consolidated switching facilities reduce switching requirements at other yards.

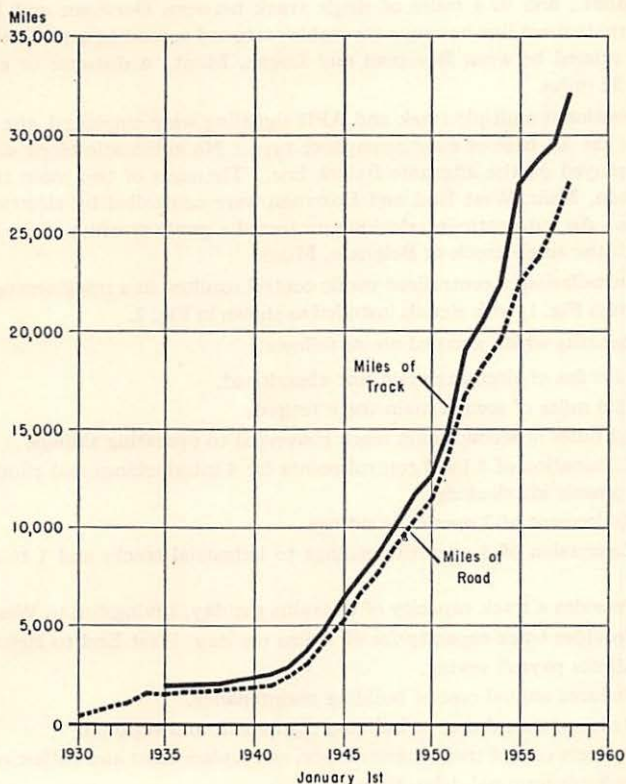
Action Recommended

Acceptance as information.



TRAIN OPERATION BY SIGNAL INDICATION
WITHOUT TRAIN ORDERS
RAILROADS OF THE UNITED STATES*

For the information of members in determining the progress of installations of train operation by signal indication without train orders, the following chart, developed from statistics of the I.C.C. Bureau of Safety and Service, is submitted:



Action Recommended

Acceptance as information.

* Previous report on this subject appears in AAR Signal Section 1950 Proceedings, Vol. XLVIII, pp. 55 and 392.

ECONOMICS OF CENTRALIZED TRAFFIC CONTROL
INVOLVING REMOVAL OF ONE MAIN TRACK*

The Northern Pacific Ry. recently completed installation of centralized traffic control between Livingston and Helena, Mont., a distance of 117.4 miles. Extending westward from Livingston, the existing line consisted of 12.4 miles of two main tracks between Livingston and Muir, Mont., 1 mile of single track between Muir and West End, Mont. which includes the 3,000-foot Bozeman Tunnel, 11.6 miles of two main tracks between West End and Bozeman, Mont., and 92.4 miles of single track between Bozeman and Helena. An alternate main line having a favorable eastward ascending grade for freight service existed between Bozeman and Logan, Mont., a distance of approximately 32 miles.

Conventional multiple track and APB signaling were employed, the signals being of the 2A base of mast semaphore type. No automatic block signaling was employed on the alternate freight line. The ends of two main track at Livingston, Muir, West End and Bozeman were controlled by electric interlockings. An automatic interlocking protected a grade crossing of the freight line with the single track at Belgrade, Mont.

The installation of centralized traffic control resulted in a track arrangement as shown in Fig. 1, with signals installed as shown in Fig. 2.

The benefits which accrued are as follows:

1. 32 miles of alternate main line abandoned.
2. 15.6 miles of second main track retired.
3. 8.2 miles of second main track converted to operating sidings.
4. Elimination of 3 local control points for 4 interlockings and elimination of 1 automatic interlocking.
5. Retirement of 7 operating sidings.
6. Conversion of 3 operating sidings to industrial tracks and 1 to a yard track.
7. Provides a track capacity of 64 trains per day, Livingston to West End.
8. Provides track capacity for 40 trains per day, West End to Helena.
9. Effects payroll saving.
10. Reduces annual cost of building maintenance.
11. Reduces annual cost of building equipment and supplies.
12. Reduces cost of track maintenance, rail replacement and ballasting.
13. Reduces terminal delay time.
14. Effects saving through reduction in train hours.
15. Effects tax benefits from property retired.

The centralized traffic control system also provides controls for the tunnel doors on Bozeman Tunnel and for electric switch heaters on each power-operated switch.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 17-A and 309-A.

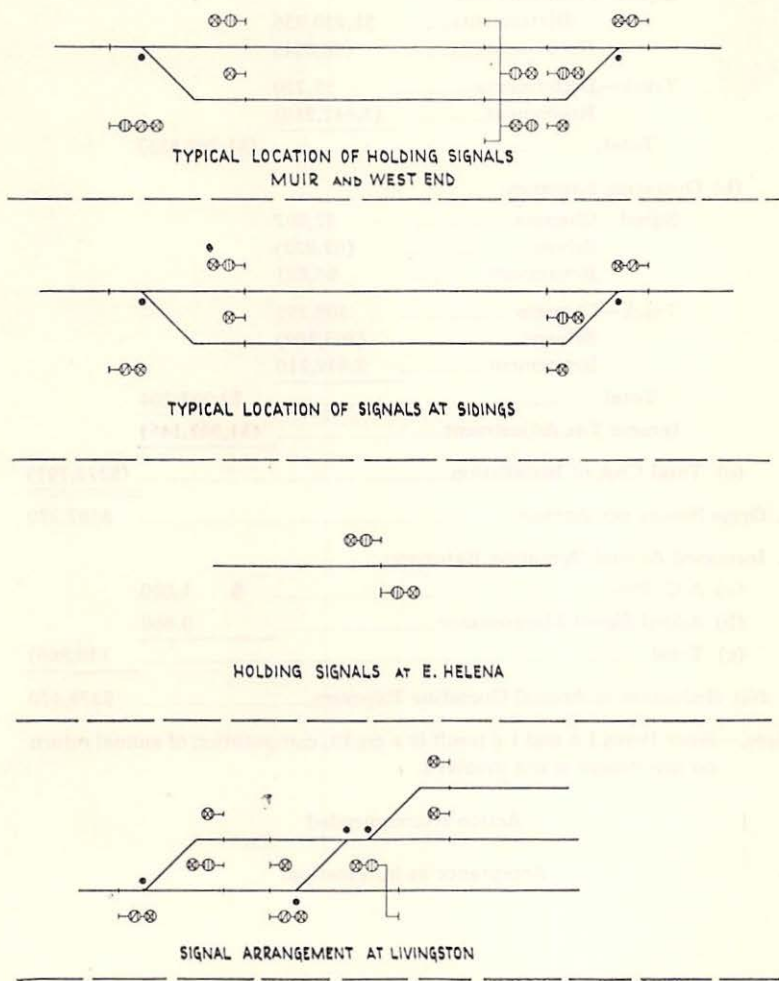


Fig. 2.

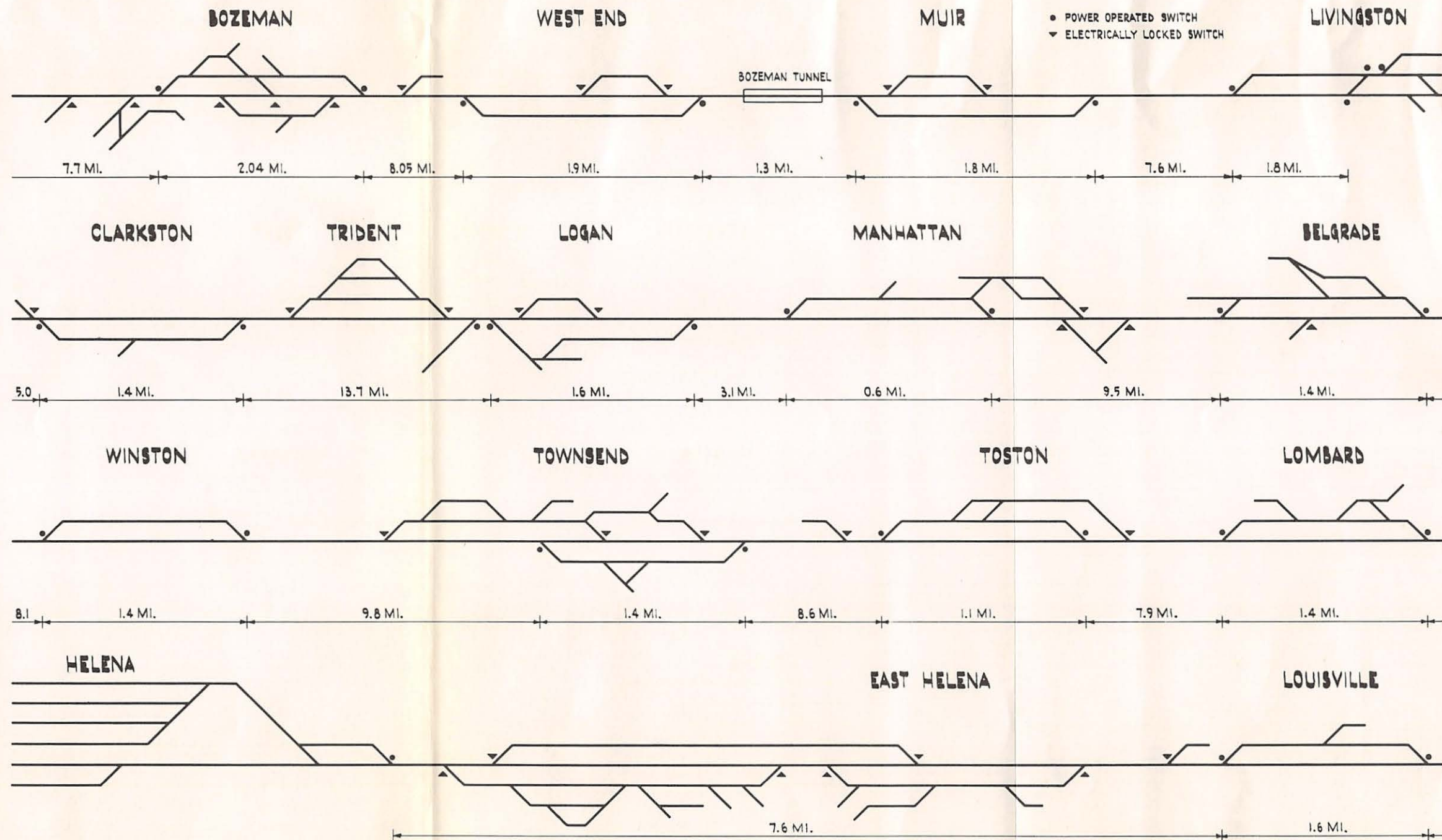


FIG. 1

Economic Statement

1. Cost of Installation:

(a) Capital Investment:

Signal—Additions and	
Betterments.....	\$1,220,956
Retirement.....	(98,821)
Track—Betterments.....	55,220
Retirement.....	(2,442,210)
Total.....	(\$1,262,855)

(b) Operating Expenses:

Signal—Changes.....	32,207
Salvage.....	(62,029)
Retirement.....	96,821
Track—Changes.....	308,295
Salvage.....	(765,300)
Retirement.....	2,442,210
Total.....	\$2,052,204
Income Tax Adjustment.....	(\$1,067,146)

(c) Total Cost of Installation..... (\$277,797)

2. Gross Saving per Annum..... \$387,330

3. Increased Annual Operating Expenses:

(a) A.C. Power.....	\$ 1,000
(b) Added Signal Maintenance.....	9,860
(c) Total.....	(10,860)

4. Net Reduction in Annual Operating Expenses..... \$376,470

Note.—Since Items 1-a and 1-c result in a credit, computation of annual return on investment is not involved.

Action Recommended

Acceptance as information.

ECONOMICS OF DEVICES FOR EXPEDITING TRAFFIC IN YARDS*

In connection with the recent installation of a large classification yard, a southeastern railway has provided a cab signal system for operation of hump engines. The Receiving Yard, from which trains are shoved to the hump, includes 16 tracks varying in length from 5,400 to 8,000 feet. In addition to these receiving tracks, thoroughfares and other tracks parallel the yard on each side. Therefore, because of the large number of tracks which are located on 14-foot centers, together with curvature in the yard and overhead bridges, hump repeater signals located at various points along the side of the Receiving Yard would not provide continuous visibility for hump engine crews shoving from tracks near the center of the yard, especially when adjacent tracks are occupied by cars.

A four-unit hump signal, controlled from hump office, is located near the top of the Yard Tower at the crest of the hump. Indications displayed by this signal are as follows:

Green.....	Approach hump at 6 miles per hour.
Yellow over yellow.....	Approach hump at 4 miles per hour.
Yellow.....	Hump at 2 miles per hour.
Red.....	Stop.
Flashing red.....	Back up.

Two engines are normally used in the humping operating, and cab signals in each engine repeat the indications displayed by the hump signal. The cab signals are inductively controlled by means of an antenna wire which parallels one side of the Receiving Yard. A tuned receiver coil is mounted on each engine which picks up appropriate frequencies required to select the proper engine and repeat the hump signal indication. A bell rings in cab of engine when indications change. Indications to approach the hump can only be displayed in one engine at a time, depending on the engine selected by hump crew foremen.

Automatic speed control for the hump engines is provided by means of an electrical and mechanical interconnection with diesel-electric controls. With this arrangement, speed of hump engines automatically follows indications displayed by the cab signals. However, enginemen can always stop or reduce speed when required.

Summary of Advantages

Advantages of cab signals and speed control for hump engines as compared with conventional hump repeater signals are as follows:

1. Provides continuous contact between hump office and hump enginemen, regardless of physical obstructions and adverse weather conditions.
2. Insures that hump engine speeds will be uniform and correspond with instructions from hump conductor.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 20-A and 310-A.

3. Relieves enginemen from having to frequently manipulate engine control in order to hump at a correct and uniform speed.
4. Eliminates the necessity of installing and maintaining numerous high masts or bridges for supporting hump repeater signals at various points in the yard.

Action Recommended

Acceptance as information.

*COMMITTEE II—CONTROLLED SIGNALING
AND INTERLOCKINGS*

Personnel

R. W. Troth, Chairman

H. A. Maynard, Vice-Chairman

B. J. Alford	H. L. Moseley
C. C. Billingslea	K. L. Muse
C. P. Huth	J. H. Sawyer
D. L. Johnson	V. P. Shepardson
C. T. Marak	R. H. Smedley
W. H. Martin	B. G. Webb
O. E. Miller	J. F. Yerger
V. S. Mitchell	V. O. Dryer*

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
6. Investigate and report on methods of installation of track circuit connections to facilitate the use of mechanized track maintenance equipment.
7. Investigate and report on all phases of retardation and automatic route selection in classification yards equipped with car retarder systems.

The committee submits for consideration, reports on the following subjects**:

1. Revision of Specification 147-49, Manual Part 27.
6. Methods of installation of track circuit connections to facilitate the use of mechanized track maintenance equipment.

Information

Specifications, etc., of other organizations referred to in the report of this committee may be procured from the following:

AIEE—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

AREA—American Railway Engineering Association, 59 E. Van Buren St., Chicago 5, Ill.

ASME—American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

ASTM—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

* Consulting member.

** Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee II at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Requisites for Switch Operating Mechanism for Slow Speed Train Movements—Now in Manual Part 182.

Specification 128-58—Mechanical Time Release—Now in Manual Part 129.

Specification 245-58—Classification Yard Control Machines—Now in Manual Part 251.

(Revision of AAR Signal Section Specification 147-49)
AAR SIGNAL SECTION SPECIFICATION 147-59.

CAR RETARDER SYSTEM

General Provisions

1. *Purpose.*

(a) This specification is for the purpose of providing for the installation of a car retarder system. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing installations when general renewal or replacement becomes desirable.

2. *Details of work.*

(a) Details of work include the following:

1. Car retarder and fittings.
2. Switch operating mechanism and fittings.
 - (a) Classification tracks.
 - (b) Other tracks.
3. Retarder controls.
4. Switch controls.
5. Control machines.
6. Signal and indicator systems:
 - (a) Hump signals.
 - (b) Repeater signals.
 - (c) Trimmer signals.
 - (d) Switch signals.
 - (e) Cab signals.
 - (f) Audible signals.
 - (g) Yard track indicators.
 - (h) Shove track indicators.
 - (i) Dragging equipment indicators.
 - (j) Broken flange indicators.
 - (k) Hot box indicators.
7. Communications system:
 - (a) Telephones.
 - (b) Loud speakers.
 - (c) Radio.
 - (d) Train communication.
 - (e) Teleprinters.
 - (f) Pneumatic tubes.
 - (g) Television.
 - (h) Facsimile.
 - (i) Recorders.

Note.—The recommended forms of construction contracts and bond will be found in the Manual of the American Railway Engineering Assn., Chapter 20—Contract Forms, Part 1.

2. *Details of work.*—Continued.

8. Buildings.
9. Power supply.
10. Power distribution system:
 - (a) Aerial.
 - (b) Surface.
 - (c) Underground.
11. Car detectors.
12. Dragging equipment detectors.
13. Broken flange detectors.
14. Hot box detectors.
15. Wires and cables.
16. Pipe lines.
17. Conduits and supports.
18. Instrument and battery housings.
19. Foundations.
20. Heaters.
21. Painting.
22. Flood and other lighting.
23. Skates.

3. *Specifications, standards, drawings, etc.*

(a) Specifications, standards, drawings, etc., referred to in the body of this specification form an essential part hereof.

(b) Purchaser's drawings should include the following:

1. General plan of yard drawn to scale of not less than 1 in. equaling 100 ft., showing track arrangement and other features pertinent to the installation in accordance with AREA Manual Chapter 14—Yards and Terminals, Part 3-D.

2. Electric or pneumatic power mains, conduit or underground cable runs, power house, location of battery and transformer housings and wire terminal locations, type and limits of track circuits and such other features as are desirable.

3. Retarders and switches to be power-operated, with length and frog angle of switches.

4. Track and velocity head profile. (Fig. 3, AREA Manual Chapter 14—Yards and Terminals, Part 3-D.)

5. Rail section, drilling and switch layouts.

6. Control tower. Drawings, dated

7. Power house, present or proposed, or both. Drawings, dated

8. Other standards and drawings including governmental regulations. Drawings, dated

(c) Contractor's drawings.

1. Contractor shall furnish with his proposal, drawings or references for the apparatus he proposes to furnish which

3. *Specifications, standards, drawings, etc.*—Continued.

are not covered by the drawings furnished by Purchaser, and shall include typical circuits.

2. After the award of contract and before work is begun, Contractor shall furnish for the approval of Purchaser, the following:

(a) Track plan showing location of retarders, switches, signals, instrument housings, cable junction boxes, cable runs, etc., within days.

(b) Detail circuit plans, within days.

(c) Instrument case wiring plans, within days.

(d) Cable diagrams, within days.

(e) Pole line diagrams, within days.

(f) Location of main air line, air strainers, including auxiliary reservoirs, valves, alcohol feeders, insulated unions, branch connections and expansion joints, within days.

3. After receipt of the drawings, Purchaser will indicate any corrections that may be necessary, or signify his approval, within days.

4. Contractor shall be responsible for the correctness of all drawings furnished by him, although the drawings may have been approved by Purchaser.

5. Any work done by Contractor prior to the approval of Contractor's drawings will be done at Contractor's risk, unless previously authorized in writing by Purchaser.

6. After contract is awarded, each party shall furnish the other, as required, prints of approved drawings.

7. No change shall be made in any approved drawing without the written consent of Purchaser.

8. After completion of contract, Contractor shall designate on general plan the location of underground cable, main air line, air strainers, auxiliary reservoirs, valves, branch connections and expansion joints.

9. After completion of contract, Contractor shall furnish Purchaser corrected tracings of drawings furnished by him.

4. *Furnished by Purchaser.*

(a) Purchaser will obtain necessary permits from Federal, State and Municipal authorities.

(b) Purchaser will furnish, as indicated in sections 4-c, d and e, material or labor, or both, on the following items:

1. Ties for support of apparatus.

2. Move ties as may be necessary.

3. Move switch and tie rods as may be necessary.

4. Insulated rail joints.

5. Bridge insulations.

6. Switch-rod insulations.

7. Tie-rod insulations.

8. Gage-plate insulations.

4. *Furnished by Purchaser.*—Continued.

9. Concrete:
 - (a) Transit mixed.
 - (b) Mixed at site.
 - (c) Precast.
10. Necessary grading and drainage.
11. Excavating of solid rock.
12. Poles for line wire.
13. Cross-arms, pins, insulators and fittings.
14. Line wire.
15. Battery housings.
16. Cables:
 - (a) Aerial.
 - (b) Underground.
17. Conduit:
 - (a) Main.
 - (b) Branch.
18. Make alterations of any part of existing structures or apparatus.
19. Prior to installation, furnish stakes establishing grade of track where required. (Fig. 3, AREA Manual Chapter 14—Yards and Terminals, Part 3-D.)
20. Rail welding where required.
21. Track bonding.
22. Gage plates.
23. Manholes.
24. Sand, clay or loam.
25. Buildings including conduit and wire chases.
26. Communications system.
27. Lighting:
 - (a) General.
 - (b) Flood.
 - (c) Control machine.
28. Power supply.
29. Air conditioning.
30. Unload and properly house materials that arrive on the ground before Contractor's force; this work to be done under the supervision of Contractor's representative.
31. Distribute material.

- (c) Material only on items
- (d) Labor only on items
- (e) Material and labor on items

(f) Purchaser will furnish the items as indicated in sections 4-c, d and e, subject to inspection of Contractor, who shall state any objections thereto before starting his part of the work. After rectification by Purchaser of any defects reported, Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by Contractor that the work done by Purchaser has not been per-

4. *Furnished by Purchaser.*—Continued.

formed in such manner as to enable him to fulfill all the provisions of the contract.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, Contractor's recommended practice shall be followed.

6. *Shipment of material.*

(a) Material shall be shipped to _____, care of _____, marked for _____. Material shipped from Contractor's factory at _____ shall be shipped via _____ and thence via _____ to destination.

7. *Transportation.*

(a) Purchaser will furnish transportation for men, necessary for the installation, over the following lines (*R-7-a):

1. _____.
2. _____.

(b) Purchaser will furnish transportation for tools and material, necessary for the installation, over the following lines (*R-7-b):

1. _____.
2. _____.

8. *Inspection of installation.*

(a) Contractor shall advise Purchaser _____ days in advance of the time installation will be completed and ready for final inspection. Purchaser will make inspection and tests within _____ days after completion of the work.

9. *Tests.*

(a) Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. These tests, unless otherwise specified, shall include the tests shown in section 9-b and shall be conducted in accordance with AAR Signal Section instructions for testing, where applicable, otherwise as directed by Purchaser. Contractor shall provide such instruments and apparatus as may be necessary for making tests. Instruments and apparatus shall remain the property of Contractor.

* Alternate requisites section.

9. Tests.—Continued.

(b) The following tests shall be made:

1. General.

(a) Determine that all circuits conform to approved circuit plans by individually electrically checking each contact selection.

(b) Determine that the electrical operating characteristics of all electrically operated devices are in accordance with Manufacturer's specifications.

2. Insulation.

(a) Determine that the insulation resistance for each complete circuit except battery and common connections is not less than 1 megohm between conductors and to ground.

3. Car retarders.

(a) Determine that retarders follow the position of the control units in the control tower and that adjustments are in accordance with Manufacturer's specifications.

4. Switch mechanisms.

(a) Determine that switches follow the position of the control unit at the control point.

(b) Determine that switch point indicator will not indicate normal or reverse position when switch points are open $\frac{3}{8}$ in. or more.

(c) Determine that electric switch motor is snubbing properly.

(d) Determine that electric switch clutch is properly adjusted.

(e) Determine that trailable feature is operating properly.

(f) Determine proper operation of switches at prescribed minimum air pressure or operating voltage and that the time from the throwing of the controlling switch lever to the completion of the switch movement shall, under normal operating conditions, occur in not more than 1.2 seconds. *R-9-b-4-f.

(g) Determine that switches will return to original position if unable to complete stroke.

5. Control machine.

(a) Determine that all positions of levers correspond with proper positions of devices on the ground.

(b) Determine that control contact adjustments conform to approved plan.

6. Track circuits.

(a) Determine that track circuits have been installed and adjusted in accordance with approved plans and specifications.

* Alternate requisites section.

9. Tests.—Continued.

7. Voltage.

(a) Determine that voltage for all apparatus is in accordance with Manufacturer's specifications.

8. Air line.

(a) Determine that air distribution system is such that leakage in any section of the system will not exceed 1 lb. in 3 minutes from normal pressure with all apparatus connected and at rest.

10. Placing in service.

(a) After receipt of written authority from Purchaser, Contractor shall place the installation in service under supervision of Purchaser, and shall leave competent men on duty for days thereafter. *R-10-a.

(b) Signal aspects shall be displayed or changed only as authorized by Purchaser.

11. Completion.

(a) When installation is completed, apparatus and surface of the ground which has been affected by the installation, shall be left in a neat and clean condition.

12. Clearances.

(a) Clearances shall conform to clearance diagram furnished by Purchaser.

Detail Provisions

13. Power supply.

(a) Purchaser will furnish volts d.c. or volts a.c., cycles, phase at points as shown on Drawing, dated, and of sufficient capacity to operate the plant properly.

14. Air compressors, governors and strainers.

(a) Air compressors, {one-stage
compound}, with a capacity of cu. ft. piston delivery free air per minute, and designed for air pressure of lbs., manufactured by, shall be furnished and installed in place on a foundation by Contractor, and constructed in accordance with the specifications which shall be attached to Contractor's bid. *R-14-a.

(b) Automatic governors shall be provided by and shall be arranged to cut in the compressor at lbs. and cut out at lbs. pressure. *R-14-b.

(c) An air strainer, approved by Purchaser, shall be installed in each air intake pipe.

* Alternate requisites section.

14. *Air compressors, governors and strainers.*—Continued.

(d) When air compressors are furnished in duplicate, interchange control panels shall be furnished for operating each compressor from either of the governors. *R-14-d.

(e) Air compressors shall be motor-driven and shall be mounted on a substantial base. Motor shall be in accordance with AIEE Standards. *R-14-e.

15. *Generator.*

(a) Alternating current generator shall be of kv-a. capacity at frequency, volts, phase, and shall be in accordance with AIEE Standards.

(b) Direct current generator shall be of k.w. capacity at volts, and shall be in accordance with AIEE Standards.

16. *Motor.*

(a) Motor shall be h.p. capacity at frequency, volts, phase a.c.; or volts d.c., and shall be in accordance with AIEE Standards.

17. *Motor-generator.*

(a) Motor-generator shall be direct-connected, mounted on a cast-iron or arc-welded steel fabricated sub-base. *R-17-a.

18. *Transformers.*

(a) Oil-cooled transformer shall be in accordance with Specification 84, Manual Part 165.

(b) Air-cooled transformer shall be in accordance with Specification 83, Manual Part 164.

(c)

19. *Rectifiers.*

(a) Rectifiers shall be of types.

(b) Rectifiers shall be in accordance with the following specifications, where applicable:

1. Copper-Oxide Rectifier—Specification 166, Manual Part 139.

2. Selenium Rectifier—Specification 229, Manual Part 243.

3. Tantalum Rectifier—Specification 189, Manual Part 47.

4.

20. *Batteries.*

(a) Batteries shall be of types.

(b) Batteries shall be in accordance with the following specifications, where applicable:

1. Nickel, Iron, Alkaline Storage Battery—Specification 49, Manual Part 15.

* Alternate requisites section.

20. *Batteries.*—Continued.

2. Lead Acid Stationary Storage Battery (Plates of Pure Lead)—Specification 58, Manual Part 19.

3. Lead Acid Stationary Storage Battery (Plates of Alloy Composition)—Specification 158, Manual Part 117.

4. Lead Acid Stationary Storage Battery (Plates of Composite Structure)—Specification 53, Manual Part 18.

5. Type "A" Copper-Oxide Caustic Soda Primary Cell—Specification 87, Manual Part 6.

6. Type "B" Copper-Oxide Caustic Soda Primary Cell—Specification 171, Manual Part 4.

7. Air Depolarized Carbon Caustic Soda Primary Cell—Specification 172, Manual Part 16.

(c) Supports for batteries in buildings shall be furnished in place by the and shall conform to Drawing , dated

(d) Storage battery shall be charged to rated capacity by before placing in service.

(e) The shall furnished with each set of main battery, one hydrometer and one battery thermometer.

(f) Installation of various types of batteries shall be in accordance with Instructions for Batteries and Cells, Manual Parts 14 and 7.

21. *Switchboards and equipment.*

(a) Switchboards and equipment shall be in accordance with Specification 107, Manual Part 153. *R-21-a.

22. *Condensers.*

(a) Condensers shall be of the atmospheric type. *R-22-a.

(b) Condensers shall be located as close to the compressor as practicable. They shall have a radiating surface of at least 1 sq. ft. per cubic ft. per minute of compressor air demand. Condensers shall be in accordance with specifications and shall be furnished and installed by

23. *Air reservoirs.*

(a) An auxiliary air reservoir for collection of condensation shall be furnished and installed for each condenser or section thereof, for each low spot in the main air pipe and at such other locations as shall be designated by Purchaser. Each reservoir shall be equipped with stop cock and blow-off pipe extending from bottom of reservoir.

(b) Extra large reservoirs called expansion tanks shall be used to provide a stand-by air supply. These reservoirs shall be properly equipped for drainage. *R-23-b.

* Alternate requisites section.

23. *Air reservoirs.*—Continued.

(c) All steel reservoirs shall be designed for 150 lbs. per sq. in. working pressure and manufactured and tested in accordance with ASME Code for Unfired Pressure Vessels. Cast-iron reservoirs shall be tested to a hydrostatic pressure of 300 lbs. per sq. in.

24. *Air pipe lines.*

(a) Air lines shall be of extra strong, galvanized steel pipe in accordance with ASTM Designation A 120 and free from zinc oxide or other foreign material that may scale off. *R-24-a.

(b) Each length of pipe larger than $\frac{3}{4}$ in. diameter shall be provided with two metallic thread protectors and one extra heavy galvanized recessed coupling, shipped separately in boxes. Pipes of lesser diameter may be shipped in bundles with one end protected with heavy burlap and the extra heavy galvanized recessed coupling turned on the pipe hand tight.

(c) Fittings.

1. Fittings (elbows, unions, valves, etc.) around the compressor plant and in pits that are accessible for inspection, maintenance, etc., shall be for at least 125 lbs. working pressure.

2. Fittings that are buried shall be AAR Mechanical Division for 300 lbs. working pressure.

3. Gate valves shall have brass seat and rising stem. *R-24-c-3.

4. Stop cocks and screw unions for $\frac{3}{4}$ in. pipe and smaller shall have brass seats. *R-24-c-4.

5. Flexible connections shall be best quality $1\frac{1}{2}$ in. reinforced or armored hose for retarders and $\frac{1}{2}$ in. for switch or skate mechanisms having 3 in. nipple inserted and securely fastened in each end and having not less than 16 in. of hose between the ends of the nipples. Complete connection shall be capable of withstanding a working pressure of 150 lbs. per sq. in.

6. Branch air line shall be taken from the top of the main air line, the connection being made by means of two street or service "L's" so arranged as to form a hinged joint to provide for expansion or by means of flexible hose.

7. Expansion joints for pipes 2 inches in diameter or larger shall have an iron body, a brass or iron sleeve and allowance for 6 in. expansion. *R-24-c-7.

8. Expansion joints shall be placed in the main air line not more than 500 ft. apart where pipe is located above ground and 1,500 ft. where pipe is located underground. *R-24-c-8.

9. Main air line, when above ground, shall be securely anchored midway between each pair of expansion joints and at ends of line.

* Alternate requisites section.

Oct. 1959]

Com. II—Controlled Signaling and Intkgs.

24. Air pipe lines.—Continued.

10. Each branch line shall contain a brass cock and union, at or near its connection with the main and if underground shall be adequately protected and accessible.

11. Check valves shall be installed in main air line as designated by Purchaser.

12. Approved type of air filter shall be installed between each branch line and pneumatically operated unit.

*R-24-c-12.

(d) Main air line shall be in good surface and so graded that condensation will run into suitable drain tanks. Main reservoirs shall be connected in series with the main air line and be provided with by-pass of the same size as the main air line. Flanges, unions, gate valves, etc., shall be provided so that main reservoirs may be removed without interrupting the flow of air through the by-pass.

(e) Pipe line installed in clean sand or gravel shall have no special protection. *R-24-e.

(f) Pipe line installed in cinder or slag ballast shall be wrapped with approved tape and surrounded by 4 in. of sand or loam.

(g) Air line when placed above the ground parallel to the track shall not be placed nearer than 6 ft. from the gage side of the rail, except by permission of Purchaser.

(h) Local conditions shall determine the height of the main air line when above ground but in all cases the bottom of the pipe shall be not less than 6 in. above the top of the ground, except by permission of Purchaser.

(i) Supports for main air line shall be placed not more than 10 ft. apart.

(j) Red lead, graphite or equivalent shall be applied to the pipe threads and only after pipe connections have been started when pipe is coupled.

(k) Each length of pipe and the fittings shall be free from dirt and scale before being coupled in the line, and care shall be exercised that no dirt gets in the line at any time. Pipe lines shall be blown out before being connected to any apparatus.

(l) Galvanizing shall be in accordance with Specifications for Metallic Coating of Metals, Manual Part 63.

25. Control machine.

(a) Control machine shall be in accordance with Specification 245, Manual Part 251.

26. Communications system.

(a) Communications system shall be in accordance with AAR Communications Section Specification.

* Alternate requisites section.

26. *Communications system.*—Continued.

(b) Telephones or telephone jacks shall be located in suitable housings at locations for communication with control tower as specified by Purchaser.

(c) Communications system shall be installed as specified by Purchaser.

27. *Foundations.*

(a) Foundations shall be rigid and level.

(b) Elevation and distance of foundations from track shall be in accordance with Purchaser's standard practice.

(c) Dimensions of concrete foundations shall conform to Drawing, dated

(d) Concrete foundations shall be allowed to properly set before any apparatus is connected thereto or placed thereon.

(e) Foundations shall be so constructed that apparatus can be removed without disturbing foundations.

(f) The Purchaser and Contractor shall jointly decide when deviations from specified sizes are necessary.

28. *Anchor bolts.*

(a) Anchor bolts for ground mast signals shall conform to Drawing 1107 or 1259.

(b) Anchor bolts for other foundations shall be in accordance with Purchaser's standard.

(c) Threads of anchor bolts shall not be imbedded in concrete foundations.

(d) Bolt holes in base castings shall be filled with waterproof and rust-resisting compound.

29. *Concrete.*

(a) Concrete shall be 1-2-4 mixture and in accordance with AREA Manual Chapter 8—Masonry, Part 1. *R-29-a.

30. *Car retarder.*

(a) Car retarder shall be in accordance with Specification 242, Manual Part 254, or Specification 246, Manual Part 253.

(b) Car retarders shall be designed to handle cars of 100 tons gross weight at a cut-off speed of $2\frac{1}{2}$ miles per hour and shall be capable of retarding such cars in accordance with velocity head profile shown on Purchaser's drawing. *R-30-b.

31. *Switch operating mechanism.*

(a) Switch operating mechanism shall be in accordance with Specification 243, Manual Part 256, or Specification 247, Manual Part 255.

* Alternate requisites section.

32. *Retarder controls.*

(a) Manual control shall provide pressure positions and shall take precedence over other control if provided.

(b) Semi-automatic retarder control shall automatically select exit speed from retarders as designated.

(c) Automatic retarder control shall provide adequate car travel and proper coupling speed based on:

1. Car weight.
2. Car rolling resistance.
3. Track fullness.
4. Track characteristics.

33. *Switch fittings.*

(a) Gage plates and rail braces shall be in accordance with Purchaser's specifications.

(b) Switch operating rods shall be in accordance with Purchaser's specifications.

(c) Arrangement and support of connections shall be such that switch points can be stopped by placing an obstruction between point and stock rail at any point of the stroke, without breaking or bending any such connections.

34. *Skate operating mechanism.*

(a) Skate operating mechanism shall be in accordance with Specification 244, Manual Part 258, or Specification 248, Manual Part 257.

35. *Skates.*

(a) Number and type of skates shall be as specified by Purchaser.

36. *Signal system.*

(a) Hump signals shall conform to the following drawings or references:

1.
2.

(b) Hump repeater signals shall conform to the following drawings or references:

1.
2.

(c) Trimmer signals shall conform to the following drawings or references:

1.
2.

(d) Switch signals shall conform to the following drawings or references:

1.
2.

36. *Signal system.*—Continued.

- (e) Cab signals shall be as specified by Purchaser.
- (f) Audible signals shall be as specified by Purchaser.
- (g) Controls for hump and trimmer signals shall be provided as specified by Purchaser.
- (h) Indicator lights repeating hump and trimmer signal indications shall be provided as specified by Purchaser.
- (i) A track circuit shall be provided approaching the hump to interlock between the hump and trimmer signals as specified by Purchaser. *R-36-i.

37. *Track circuits.*

- (a) Detector track circuits shall be provided as shown on Drawing, dated and as specified by Purchaser.
- (b) Clearance track circuits shall be provided as specified by Purchaser.
- (c) Car location track circuits shall provide indication of distance to coupling as specified by Purchaser.

38. *Switch control.*

- (a) Manual control shall be provided for each switch as designated and shall take precedence over automatic control if provided.
- (b) Automatic switching shall be provided. *R-38-b.
 - 1. Automatic switching shall be so arranged that switches operate automatically to route cut to a selected track. The system shall provide storage and indication for routes.
 - 2. Program switching shall be so arranged that routes will be stored and routes indicated.
 - (a) Means shall be provided to cancel stored information and insert new destinations as required before reaching first automatic controlled switch.
 - (b) Means shall be provided to simulate movement of cuts through automatic switching limits.
- (c) Control machine in retarder tower shall provide for manual control of retarders and switches. *R-38-c.
- (d) Push button selection of routes shall be provided for the hump conductor. *R-38-d.
- (e) Test panel.
 - 1. Test panel shall be provided with a track diagram equipped with storage indication lights showing switch position and track occupancy.
 - 2. Lights to indicate relative car weights, light, medium or heavy, shall be provided.

* Alternate requisites section.

38. *Switch control.*—Continued.

3. An indication showing destination of the next cut approaching junction switch shall be provided.

4. A switch shall be located at each turnout to permit de-energizing track relays in sequence to simulate the movement of cars, and check operation of automatic route selection of switch machine.

(f) Code storage and transfer.

1. Storage shall be provided to indicate routes for cuts leaving the crest of the hump.

2. At each switch other than the first automatically controlled switch after leaving the hump, there shall be provided as many storages as the maximum number of cuts that can be between that switch and the switch that precedes it during maximum rate of humping, as specified.

39. *Switchboard circuits.*

(a) Contractor's recommended arrangement of circuits shall be followed, subject to modification to meet Purchaser's special requirements.

40. *Special circuits.*

(a) The special circuit requirements, in detail, are as follows:

1.
2.

41. *Wires and cables.*

(a) Wires and cables shall be in accordance with the following specifications (*R-41-a):

1. Specification for Galvanized Steel Strand, Manual Part 184.
2. Line Wire—Specification 168, Manual Part 173.
3. Insulated Wire—Specification 111, Manual Part 186.
4. Stranded Aluminum Line Wire—Specification 54, Manual Part 24.
5. Braid-Covered Cable—Specification 89, Manual Part 25.
6. Lead Sheathed Cable, Submarine—Specification 90, Manual Part 26.
7. Lead Sheathed Cable, Non-Armored—Specification 91, Manual Part 28.
8. Lead Sheathed Cable, Armored—Specification 145, Manual Part 20.
9. Polychloroprene Sheathed Cable with Outer Covering—Specification^a 161,^f Manual Part 36.
10.
11.

* Alternate requisites section.

42. *Size of wire.*

(a) Wire shall be of sufficient size to permit operation of car retarder, skate, switch and signal operating mechanisms in accordance with this specification.

(b) Single-conductor wires external to the control tower shall be not smaller than No. A.W.G. Single-conductor wires within the control tower shall be not smaller than No. A.W.G.

(c) Wires in cable external to the control tower shall be not smaller than No. A.W.G.

(d) Line wires shall be not smaller than No. A.W.G. for hard-drawn copper or No. A.W.G. for copper-covered steel.

(e) In cables, spare wires shall be provided as designated by Purchaser.

(f) Size and description of circuit conductors shall be as follows:

	Mfgr. desig. (a)	A.W.G. (b)	Material (c)	Thickness of insulation (d)	Braid (e)	Tape (f)
1. Track transformers or batteries to rail.....						
2. Relay to each rail.....						
3. Fouling shunt connections.....						
4. Series track connections..						
5. Switch circuit controller shunt connections.....						
6. Line drops.....						
7. Power line drops.....						
8. Signal wires.....						
9. Switch wires.....						
10. Ground wires.....						
11. Signal lighting wires.....						
12. Inside wiring (cases, etc.)						
13. Aerial wire.....						
14. Transmission line.....						
15. Retarder controls.....						
16. Skate controls.....						
17. Relay leads.....						
18. Aerial cables.....						
19. Underground cables.....						

43. *Wiring.*

(a) Wiring shall be in accordance with Instructions for Wiring, Manual Part 84.

(b) Lead cable underground without other mechanical protection shall be placed in conduit.

(c) Equipment racks for the system shall be factory wired complete with inter-rack wiring. Wiring shall be checked at the factory and properly tagged for shipment.

44. *Overload devices.*

(a) Fuses shall be:

	Type	Voltage	Capacity
1.			
2.			

(b) Fuse clips shall be mounted on an insulating base of fire-proof material.

(c) Circuit breakers shall be:

	Type	Voltage	Capacity
1.			
2.			

(d) Fuses or circuit breakers shall be installed according to Contractor's standard practice as approved by Purchaser.
*R-44-d.

(e) Fuses or circuit breakers outside of buildings shall be enclosed in weatherproof housings.

45. *Bonding.*

(a) Track circuit bonding shall be type, and installed in accordance with Specification 135, Manual Part 22.

46. *Relays.*

(a) Relays shall be of types.

(b) Relays shall be in accordance with the following specifications, where applicable:

1. Tractive armature d.c. neutral relays shall be in accordance with Specifications 105 and 154, Manual Parts 123 and 101.

2. Tractive armature d.c. polarized relays shall be in accordance with Specification 165, Manual Part 137.

3. Tractive armature d.c. neutral relays, plug-in type, shall be in accordance with Specification 204, Manual Part 77.

4. Alternating current relays shall be in accordance with Specifications 78 and 148, Manual Parts 122 and 53.

(c) Relays shall be provided with spare contacts where practicable.

(d) Non-vital plug-in relays and plug-coupled storage units shall be in accordance with Contractor's recommendations.

47. *Reactors and resistors.*

(a) Reactors shall be in accordance with Specification 104, Manual Part 121.

(b) Resistors shall be in accordance with Specification 106, Manual Part 135.

* Alternate requisites section.

48. *Circuit controllers.*

(a) Switch circuit controllers shall be in accordance with Specification 95, Manual Part 49. *R-48-a.

(b) Switch circuit controller connections shall conform to Drawings 1255, 1256, 1271 and 1272. *R-48-b.

(c) Switch circuit controllers shall be connected to the near switch point.

(d) circuit controllers shall be in accordance with

49. *Lightning arresters.*

(a) High-voltage arresters, type, shall meet AIEE requirements and shall be installed as shown on circuit drawings.

(b) Low-voltage arresters, type, shall meet the requirements of Specification 52, Manual Part 95, and shall be installed as shown on circuit drawings. *R-49-b.

(c) Arrester grounds shall be in accordance with Specification 60, Manual Part 92. Contractor's liability is limited to grounding elements per ground.

50. *Bootlegs.*

(a) Bootlegs shall conform to Drawing, dated

51. *Track circuit connectors.*

(a) Track circuit connectors shall conform to Drawing 1632. *R-51-a.

52. *Junction boxes.*

(a) Junction boxes shall conform to Drawing, dated

(b) Junction boxes shall be located as shown on Drawing, dated

53. *Terminal boxes.*

(a) Terminal boxes shall conform to Drawing, dated

54. *Conduits.*

(a) Conduits shall be in accordance with AAR Communications Section Specification.

55. *Wire chases.*

(a) Wires within the control tower shall be in conduit or chase of fireproof construction. Provision shall be made by Purchaser in the control tower walls and floors for proper housing of all

* Alternate requisites section.

55. *Wire chases.*—Continued.

wires between machine and equipment racks and between terminal boards and outside of the control tower. Wire chase in the equipment room for carrying inter-rack wires shall be furnished as specified by Purchaser.

56. *Line material.*

(a) Cross-arms and pole line hardware shall be in accordance with AAR Communications Section Specifications.

(b) Insulators for distribution system shall be of type, material.

(c) Insulators for low-voltage circuits shall be of type, material.

(d) Pin type porcelain insulators shall be in accordance with Specifications for Pin Type Insulators, Manual Part 160.

57. *Instrument housings.*

(a) Instrument housings shall conform to the following drawings or references:

1.
2.

58. *Battery housings.*

(a) Concrete battery boxes shall conform to Drawings 1266, 1267, 1268 and 1269.

(b) Steel battery boxes shall conform to Drawings 1520 and 1522.

(c) Battery boxes shall conform to Drawing dated

59. *Insulated rail joints.*

(a) Insulated joints shall be type and for section, lb. rail with hole drilling.

(b) Insulated joints shall be installed in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

60. *Switch-rod insulation.*

(a) Switch-rod insulation shall conform to Drawing 1055.
*R-60-a.

61. *Fibre insulation.*

(a) Fibre insulation shall be in accordance with Specification 13, Manual Part 58.

62. *Painting.*

(a) Painting shall be in accordance with Instructions for Painting, Manual Part 110.

* Alternate requisites section.

63. *Padlocks.*

(a) Purchaser's padlocks shall be furnished by
and shall be used where specified.

64. *Computers.*

(a) Computers shall be in accordance with Contractor's
recommendations.

65. *Weight detector.*

(a) Weight detector shall be in accordance with Contractor's
recommendations.

66. *Car detector.*

- (a) Car detector shall be:
1. Light type.
 2. Track treadle type.
 3.

67. *Radar.*

(a) Radar frequency shall be mc.

68. *Yardmaster car counter.*

(a) Yardmaster car counter shall be as specified by Purchaser.

69. *Dragging equipment detector.*

(a) Dragging equipment detector shall be as specified by
Purchaser.

70. *Hot box detector.*

(a) Hot box detector shall be as specified by Purchaser.

71. *Broken flange detector.*

(a) Broken flange detector shall be as specified by Purchaser.

Alternate requisites.

R-7-a.

Contractor will furnish transportation for men, necessary for
the installation, over the following lines:

1.
2.

R-7-b.

Contractor will furnish transportation for tools and material
necessary for the installation, over the following lines:

1.
2.

R-9-b-4.f.

Determine proper operation of switches at prescribed minimum
air pressure or operating voltage and that the time from the
throwing of the controlling switch lever to the completion of the
switch movement shall, under normal operating conditions,
occur in not more than seconds.

Alternate requisites.—Continued.

R-10-a.

Purchaser will place the installation in service in the event that he does not authorize Contractor to do so within days after completion of the work to Purchaser's satisfaction.

R-14-a.

1. Air compressor and foundation shall not be furnished.
2. Foundation shall be furnished by Purchaser.

R-14-b.

Automatic governors shall not be provided.

R-14-d.

Duplicate panels shall not be provided.

R-14-e.

Air compressors shall be driven.

R-17-a.

Motor-generator shall not be direct-connected.

R-21-a.

Switchboard shall be in accordance with

R-22-a.

Condensers shall be of the type.

R-23-b.

Extra large reservoirs called expansion tanks to provide a stand-by air supply shall not be used.

R-24-a.

Air lines shall be of extra strong, galvanized wrought iron in accordance with ASTM Designation A 72 for underground service, and extra strong, galvanized steel pipe in accordance with ASTM Designation A 120 for service above ground and free from zinc oxide or other foreign material that may scale off.

R-24-c-3.

Gate valves shall have

R-24-c-4.

Stop cocks and screw unions for $\frac{3}{4}$ in. pipe or smaller shall be

R-24-c-7.

Expansion joints for pipes 2 inches in diameter or larger shall have

R-24-c-8.

Expansion joints shall be placed in the main air line not more than ft. apart where pipe is located above ground and ft. where pipe is located underground.

Alternate requisites.—Continued.

R-24-c-12.

Air filter shall not be furnished.

R-24-c.

All pipe shall have approved protection.

R-29-a.

Concrete shall be mixture in accordance with
Specification, dated

R-30-b.

Car retarders shall be designed to handle cars of
tons gross weight at a cut-off speed of miles per hour.

R-36-i.

A track circuit shall not be provided approaching the hump to
interlock between the hump and trimmer signals.

R-38-b.

Automatic switching shall not be provided.

R-38-c.

Control machine in retarder tower shall provide for manual
control of retarders and switches, and push button selection of
routes.

R-38-d.

Push button selection of routes shall not be provided for the
hump conductor.

R-41-a.

Wires and cables shall be in accordance with
.....

R-44-d.

Fuses or circuit breakers shall be installed as follows:
.....
.....

R-48-a.

Switch circuit controllers shall be

R-48-b.

Switch circuit controller connections shall conform to
.....

R-49-b.

Low-voltage arresters, type, shall be of the non-
valve, gap type and shall be installed as shown on circuit draw-
ings.

Alternate requisites.—Continued.

R-51-a.

Track circuit connectors shall conform to Drawing
dated

R-60-a.

Switch-rod insulation shall conform to Drawing
dated

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 147-49—Car Retarder System, Manual Part 27.

METHODS OF INSTALLATION OF TRACK CIRCUIT
CONNECTIONS TO FACILITATE THE USE OF
MECHANIZED TRACK MAINTENANCE
EQUIPMENT

At the 1958 Annual Meeting* Committee II presented a report including six typical drawings showing method of installation of track circuit connections in use on various railroads.

This supplemental report includes drawings showing additional methods of installations which have been approved or are under test by three different railroads. Each of these roads are heavy users of mechanized track maintenance equipment and are vitally concerned with the problems and expense caused from interference by track circuit connections.

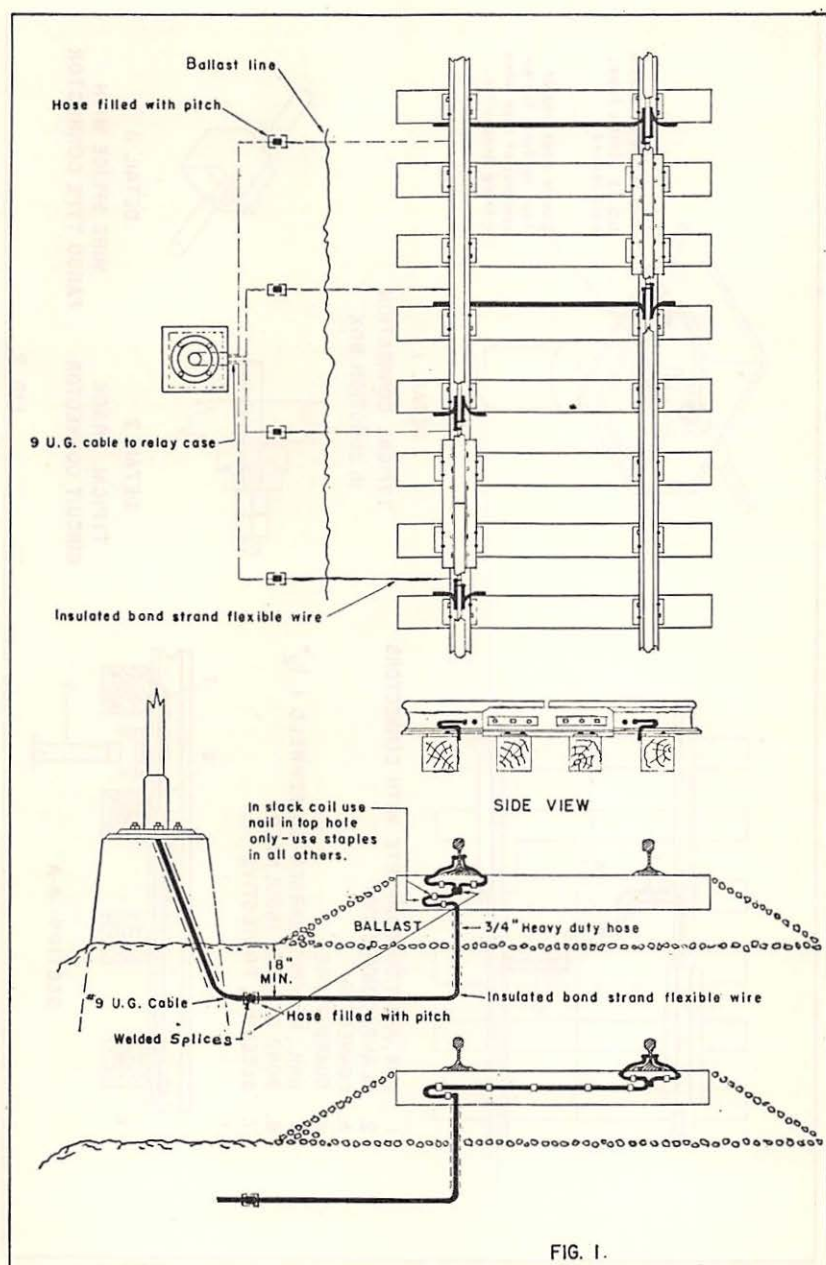
Figure 1 shows method of installation under test by one railroad which is a pioneer in the use of mechanized track maintenance equipment. This method dispenses with bootlegs and eliminates interference caused by track circuit connections to the use of mechanized track maintenance equipment excepting the ballast sled and plow, and undercutter. It will be noted that a large percentage of the in-service materials remain intact by installing a piece of insulated stranded No. 9 wire between existing No. 9 solid underground cable and rail connections by means of welded splices. The splices are taped and made moisture-proof as shown.

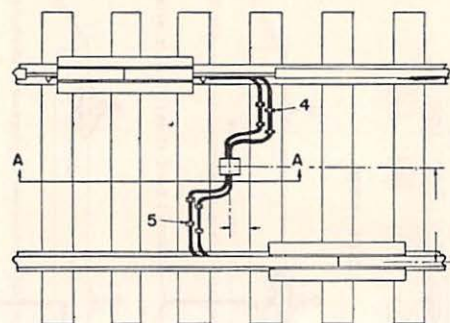
Figure 2 shows approved method of installing track circuit connections on one railroad which uses practically every type of mechanized track maintenance equipment available. As indicated on Fig. 2, a four-way bootleg is installed in the center of track between ties, with rail connectors stapled to top of ties. The far connectors are placed behind the insulated joint bars and protected against mechanical damage with a fiber glass outer covering. This method of installation eliminates interference with the use of mechanized track maintenance equipment excepting the ballast sled and plow, and undercutter.

Figure 3 shows method of installation under test by another railroad which is also a heavy user of mechanized track maintenance equipment. The installation is similar to that described under Fig. 2. The main difference is that Fig. 3 employs two two-way telescopic type bootlegs with track circuit connectors located outside of angle bar limits. The intended purpose of the telescopic type bootleg is to provide a quick and simple method of raising it when the track is raised without disturbing the roadbed or the buried portion of the underground cable.

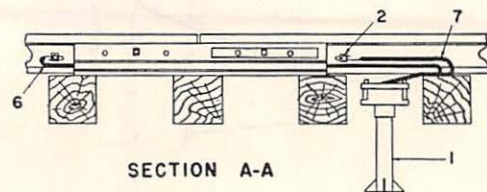
It is recognized that bootlegs shown in Figs. 2 and 3 are vulnerable to damage by hydraulic devices used with some types of mechanized track maintenance equipment; however, in the operation of this equipment it is not necessary to utilize every space between ties, and damage to the bootleg can be avoided if the operator of the equipment is made aware of its location.

* AAR Signal Section 1957 Proceedings, Vol. LV, pp. 30-A and 282-A.

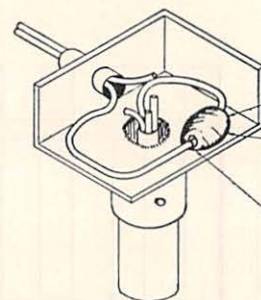




1. BOX, JUNCTION—COMPLETE WITH CONNECTORS
2. CLAMP, CONNECTOR
3. CONNECTOR
4. GUARD, FIBRE
5. NAIL, ROOFING—BARBED COPPERWELD 1 1/2"
6. BOND STRAND, INSULATED
7. SLEEVING, PROTECTIVE



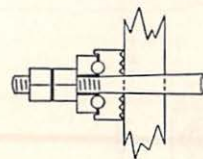
SECTION A-A



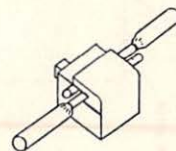
Two layers of Scotch NO. 33 plastic tape, half lapped.

Double back end of tape to form tab for removal of tape when making inspection.

DETAIL 1

TYPICAL CONNECTION
IN JUNCTION BOX

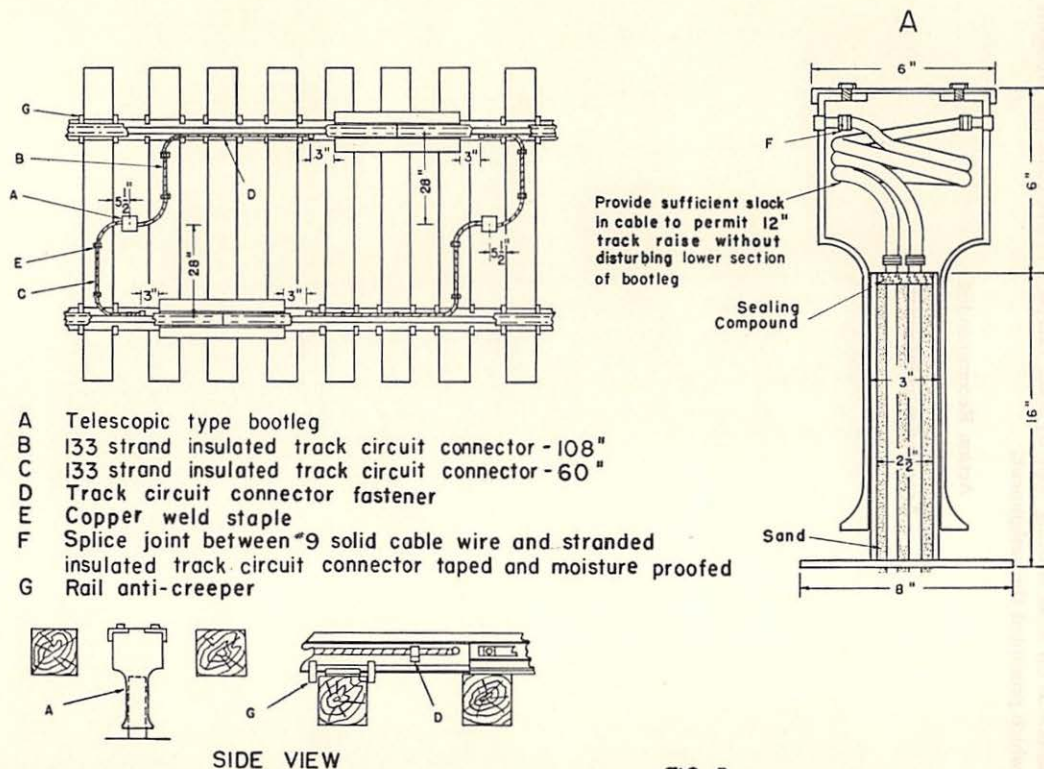
DETAIL 2

TYPICAL TRACK
CIRCUIT CONNECTOR

DETAIL 3

WIRE SPLICE WITH
FARGO TYPE CONNECTOR

FIG. 2.



The committee desires to emphasize that the installations described under Figs. 1, 2 and 3 are still in the experimental stage and are subject to revision as experience warrants. The purpose of this report is to keep the membership informed on what is being done by some railroads to overcome the problems which prompted the assignment.

Action Recommended

Acceptance as information.

COMMITTEE III—SIGNAL SHOP PRACTICE

Personnel

J. P. Stevely, Chairman

L. G. Hogan, Vice-Chairman

P. P. Ash	W. L. Scott
U. H. Auckerman	F. V. Sloop
W. W. Bell	J. F. Stanford
D. C. Bettison	H. V. Stone
L. H. Dyke	A. B. Swartzwelder
I. E. Harshbarger	E. A. Thompson
A. C. Krout	W. B. Van Lear
R. F. Miller	A. T. Johnston*

R. J. Little*

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Investigate and report on shop practices:
 - (a) Assembly of signal components for field installation projects.
 - (c) Repair of signal apparatus.
 - (d) Reclamation of signal and associated material.
4. Investigate and report on methods of handling materials between signal shop and field forces.
6. Investigate and report on noteworthy practices used in repairing signal apparatus.
7. Investigate and report on devices not commercially available, used in repairing signal apparatus.

The committee submits for consideration, reports on the following subjects**:

3. Shop practices for repair of graphic recording instruments.
Shop practices for repair of electro-pneumatic switch valves.
6. Shop practices for repair of switch circuit controller shafts.
Shop practices for repair of switch point roller bearings.
7. Relay test panel.
Device for checking air cylinder efficiency.

* Consulting member.

** Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

RELAY TEST PANEL

A relay test station, developed by a Member Road, and in use a number of years, has proved to be very efficient. The station consists of a kneehole test bench with drawers on each side, a test panel and an angle iron frame on which the relay being adjusted is mounted at eye level. Local lighting is provided by a two-tube 30-watt fluorescent fixture mounted on a floating arm which permits positioning the light at any point and directing it in any direction.

Figure 1 shows bench top, relay support and front of test panel.

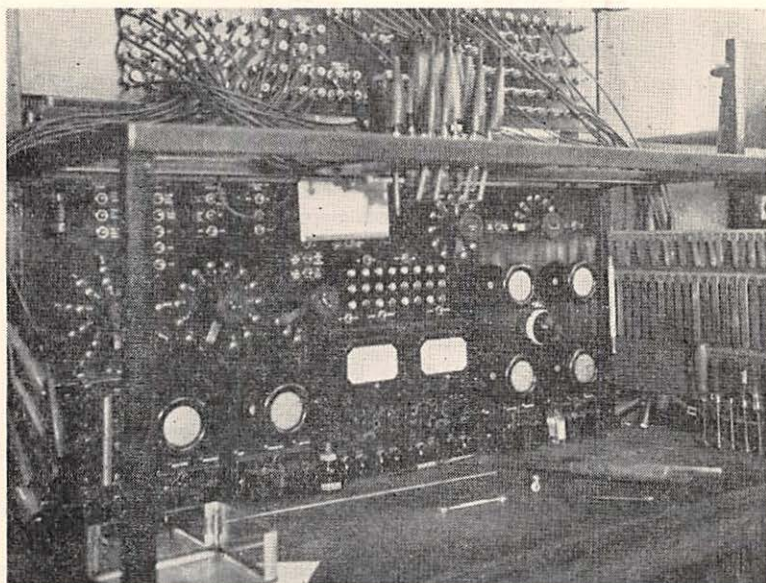


Fig. 1.

Figure 2 shows the rear view of the test panel.

The test panel is 18 inches high and 43 inches long. Mounted on the panel are all switches, meters, rheostats and indicator lights to test relays ranging from 0.08 ohm to 2,200 ohms. Connections to relay are made by test leads connected to terminal posts on panel and provided with test clips for connection to relay terminal posts. An indicator light is provided for each contact. This is very helpful when adjusting contacts, as well as to check their proper functioning during test. Circuiting is so arranged that a short circuit will not result from improper operation of switches. As a separate unit, a low-resistance ohmmeter is provided for testing relay contact resistance, the energy for which is controlled by a foot switch, leaving the testman's hands free to handle the test clips.

Figure 3 shows the relay test panel layout and the type and function of equipment.

Oct. 1959]

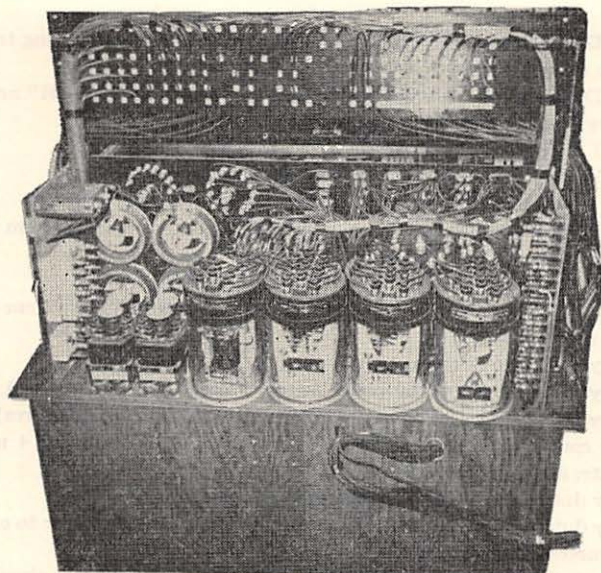


Fig. 2.

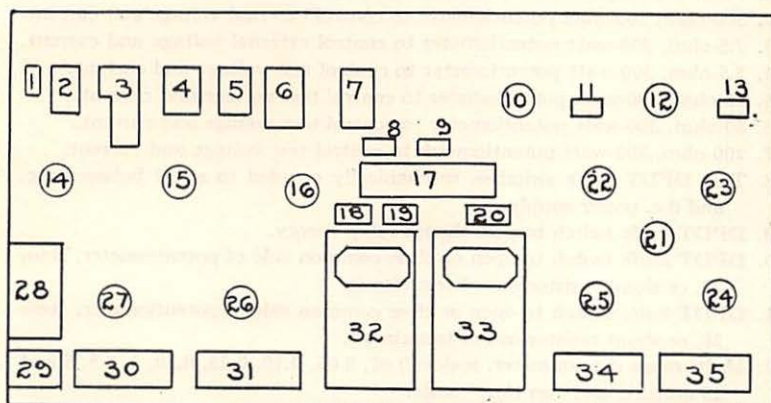


Fig. 3.

Following are the items shown by number reference on Fig. 3:

Item

1. Fuse (10-ampere).
2. Three heavy duty DPST toggle switches to control 510-ohm shunt resistor, 50-ohm series resistor and cut-in code transmitters.
3. Two DPDT and three SPST toggle switches to control code transmitters.
4. Three DPDT toggle switches to select code transmitter contacts.
5. A DPST and two SPST toggle switches to control the 0.3-ohm CD track relay test.

Item

6. Four DPDT and two DPST toggle switches to connect decoding test unit into circuit.
7. Four DPST toggle switches to cut indicator lights through "H" and "D" relays, and to connect d.c. ammeter into decoding unit test.
8. DPDT toggle switch to select a.c. or d.c. for indicator lights.
9. DPST toggle switch to turn indication lights on or off.
10. Rotary switch to select external battery voltage (1.5 to 120 volts).
11. SPST toggle switch to open common side of potentiometer, Item 22, for use as a rheostat.
12. Rotary switch to select matching lamp for check of LOR.
13. SPST toggle switch to open common side of potentiometer, Item 23, for use as a rheostat.
14. Rotary switch to select a.c. test voltage (1 to 110 volts).
15. Rotary switch to select test panel battery voltage (1.5 to 120 volts).
16. Rotary switch to select ammeter connection (2.5, 5, or 25 amperes).
17. Relay contact indicator lights: 8 front, white; 8 back, green; 4 normal, white, and 4 reverse, red.
18. Heavy duty DPST toggle switch ammeter shunt.
19. Heavy duty toggle switch to connect ammeter to test circuit or to external ammeter test terminals.
20. Heavy duty DPDT toggle switch to connect voltmeter to test circuit or to the external voltmeter test terminals.
21. Four-way snap switch to select coils in relays for independent coil operation.
22. 300-ohm, 300-watt potentiometer to control external voltage and current.
23. 7.5-ohm, 300-watt potentiometer to control external voltage and current.
24. 7.5-ohm, 300-watt potentiometer to control test voltage and current.
25. 15-ohm, 300-watt potentiometer to control test voltage and current.
26. 50-ohm, 300-watt potentiometer to control test voltage and current.
27. 200-ohm, 300-watt potentiometer to control test voltage and current.
28. Two DPDT knife switches, mechanically coupled to select between a.c. and d.c. power supply.
29. DPDT knife switch to pole change relay energy.
30. DPDT knife switch to open or close common side of potentiometer, Item 27, or shunt resistor out of test circuit.
31. DPDT knife switch to open or close common side of potentiometer, Item 26, or shunt resistor out of test circuit.
32. Multi-range d.c. ammeter, scales: 0.01, 0.05, 0.10, 0.25, 0.50, 1, 2.5, 5 and 25 ampere, and "on time" scale.
33. Multi-range a.c.-d.c. voltmeter, scales: d.c. only, 0.1, 0.25, 0.50 and 1; a.c.-d.c., 2.5, 5, 10, 25, 50 and 100; d.c. only, 500; a.c. only, 250.
34. DPDT knife switch to open or close common side of potentiometer, Item 25, or shunt resistor out of test circuit.
35. DPDT knife switch to open or close common side of potentiometer, Item 24, or shunt resistor out of test circuit.

Figure 4 (folded sheet following this page) shows the wiring diagram of the relay test panel.

Action Recommended

Acceptance as information.

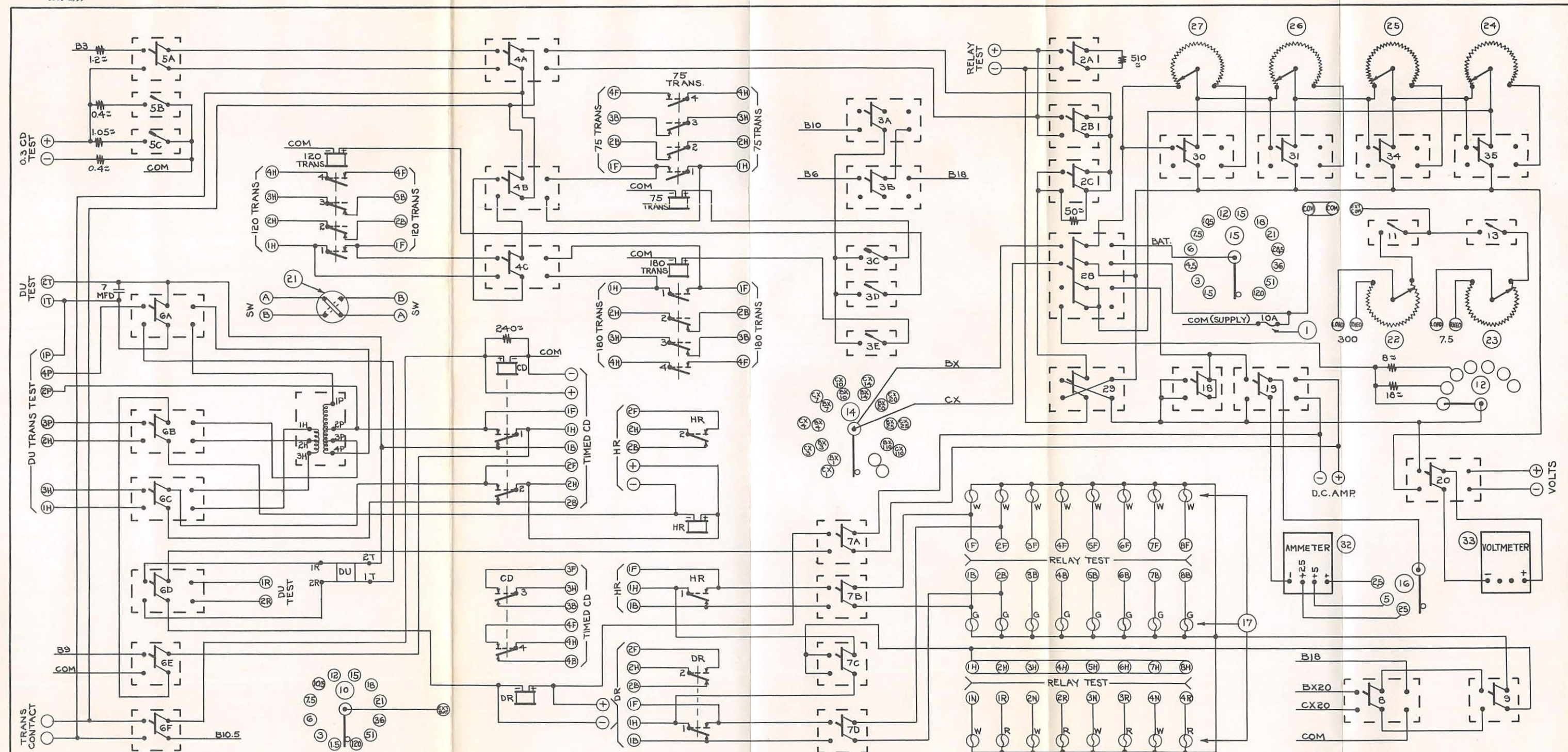
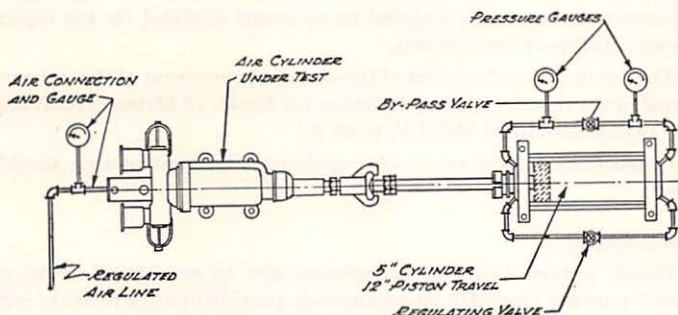


FIG. 4

NOTE:
ALL DOUBLE THROW SWITCHES ARE NORMAL IN
THE LEFT POSITION
ALL SINGLE THROW SWITCHES ARE NORMAL IN
THE OPEN POSITION WITH THE EXCEPTION OF 2B & 2C

DEVICE FOR CHECKING AIR CYLINDER EFFICIENCY

A device for checking air cylinder efficiency, shown in Fig. 1, has been developed by a Member Road and is presently in use at their Signal Shop. It is used primarily to test direct-acting switch mechanisms after they have been repaired.



NOT TO SCALE

Fig. 1.

This device consists essentially of a cylinder filled with oil, Specification 103, Manual Part 107, and is equipped with necessary regulating and by-pass valves. The regulating valve permits varying the pressure on either side of the piston to determine the efficiency (or condition) of the air cylinder being tested. The by-pass valve, when open, permits free operation.

Action Recommended

Acceptance as information.

SHOP PRACTICES FOR REPAIR OF GRAPHIC
RECORDING INSTRUMENTS*1. *Organization.*

(a) The number of graphic recording instruments to be repaired may not require a full-time assignment of one or more employees to this class of work. This report covers only the repair of chart drive mechanisms. The repair of these instruments is usually assigned to personnel qualified for the repair of meters and clockwork mechanisms.

(b) The repair and replacement of the electrical movement of the instrument is covered in the report on "Shop Practices for Repair of Meters," AAR Signal Section 1957 Proceedings, Vol. LV, p. 57-A.

(c) Instructions for the repair of graphic recording instruments should be provided.

2. *Shop space.*

(a) Repair section should be of sufficient size to provide adequate work space and is usually located in an area already provided for the repair of instruments requiring a clean, dust-free, well lighted, well ventilated and adequately heated area. Work benches should be arranged at a comfortable height.

3. *Equipment.*

(a) The equipment provided will fall into two classes, established as follows:

1. The following equipment should be provided when repairs are limited to replacement of defective parts, cleaning and oiling:

- (a) Electric oven.
- (b) Socket wrench set.
- (c) Screwdriver set.
- (d) Jeweler's loupe.
- (e) Tweezers.
- (f) Lubrication applicators.
- (g) Containers for disassembled parts.
- (h) Small low-pressure hand blow gun.
- (i) Small soldering gun.

2. The following equipment, in addition to the above, should be provided when repairs to escapement and other parts are to be performed in the shop:

- (a) Jeweler's lathe.
- (b) Bench type drill press, $\frac{1}{4}$ " capacity.
- (c) Drill set, Nos. 1 to 80, inclusive.
- (d) Pin vise.
- (e) Small bench vise.

4. *Procedure.*Step 1. *Inspection.*

Graphic instrument or chart drives only received for repair should be accompanied by information regarding the complaint.

* The term "as instructed" as used herein refers to individual railroad instructions.

4. *Procedure.*—Continued.

Electrical movements should be handled in accordance with section 1-b.

Chart drive mechanism complete with chart should be operated to verify the complaint and to determine the probable defect.

Step 2. Dismantling.

Motive power for the instrument may be supplied from hand-wound springs or a self-starting synchronous motor. Do not remove the escapement or the mainspring from a spring-driven instrument without first unwinding or letting down the springs in accordance with manufacturer's instructions.

The chart drive should be dismantled carefully, making certain that parts are not damaged during this operation. Parts removed should be examined closely to determine whether repair or replacement is necessary. Each part suitable for reuse should be set aside. Defective parts should be discarded or set aside for repairs in accordance with established shop policy.

Step 3. Repairs.

Worn bearings should be rebushed and all bearing surfaces must be smooth and free of undue friction unless otherwise instructed.

Defective parts should be repaired or replaced with new parts.

All parts to be assembled should be cleaned thoroughly with an approved cleansing agent. The parts should be handled carefully and not exposed to dust or other foreign matter after cleaning.

The main springs should be lubricated before assembly in accordance with manufacturer's instructions.

When the synchronous motor is employed as motive power, it should be carefully checked and repaired if necessary.

Step 4. Assembly.

The bearings should be lubricated in accordance with manufacturer's instructions. The parts should again be handled carefully and it should be observed that all bearings fit properly, that all gears have proper clearances and that shafts have sufficient end play. After assembly of the chart drive mechanism, set the inkwell in place, making sure that the springs hold it firmly and insert pen elements. Install a chart and make certain that pens are in proper alignment.

Step 5. Checking.

Make certain that all screws and nuts are in place and properly tightened and that clutch is properly adjusted.

Start the mechanism and make certain that sufficient torque is available at the chart drive roll and that the reroll is functioning properly. Be sure that the pins, where provided on the chart roll, properly engage the perforations on the edge of the chart with no tendency of the paper to climb off the pins while the recorder is in operation. The completely assembled chart drive should be

4. Procedure.—Continued.

fully wound and allowed to run for a suitable period. The timing adjustment should be made during this test. During the above test period the chart drive should be installed in a suitable dust-proof case.

Step 6. Final inspection.

The chart drive should be given a final test run during which it should be observed that the timing is within specifications and that all parts are functioning properly.

Step 7. Preparing for shipment.

Necessary records should be made and the assembled instrument or chart drive tagged or marked as instructed.

Remove pen elements and inkwell, clean and place in special mounting box for shipment with the instrument. Each instrument should be accompanied by a pen filler, an inkwell filler and its instruction book.

The complete instrument or chart drive if separate should be placed in a special shipping container, tightly cushioned with heavy denim-covered hair felt pads or sponge rubber at least 5 inches in thickness. Container should be plainly marked to indicate that special care in handling is required.

Action Recommended**Acceptance as information.**

SHOP PRACTICES FOR REPAIR OF ELECTRO-PNEUMATIC SWITCH VALVES*

1. *Organization.*

(a) The number of electro-pneumatic (EP) switch valves to be repaired may not require a full-time assignment of one or more employees to this class of work. After the approximate number of valves to be repaired and the average time per unit has been determined, the force can be set up to meet the requirements.

(b) The personnel should be trained in the repairing, adjusting and testing of EP switch valves.

(c) Instructions and specifications for repairing, adjusting and testing of EP switch valves should be provided.

(d) Instructions for determining which valves are to be repaired should be provided. (In the preparation of these instructions, see "Salvaging or Repairing of Signal Material," AAR Signal Section 1952 Proceedings, Vol. L, p. 59.)

2. *Shop space.*

(a) Repair section should be of sufficient size to provide adequate work space for the force required. It should be clean, well ventilated, well lighted and with work benches arranged at a comfortable height.

3. *Equipment.*

(a) The following equipment should be provided, as required:

1. Hand tools including socket wrenches, soldering irons, gages, micrometer calipers, toolmaker's calipers and dividers.
2. Clean dry air supply.
3. Small low-pressure hand blow gun.
4. Portable electric drill, $\frac{1}{4}$ " capacity.
5. Power drill press.
6. Power-driven grinding and buffing wheels.
7. Valve grinding and reseating set.
8. Bench vises.
9. Drying oven.
10. Dielectric test set.
11. Suitable power supply.
12. Test panel.
13. Suitable air gages.
14. Suitable voltmeter and ammeter.
15. Work benches and storage bins.

4. *Procedure.*Step 1. *Inspection.*

Visual inspection should be made for classification of repair, salvage or scrap. Valves to be repaired or salvaged should be placed in classified storage.

* The term "as instructed" as used herein refers to individual railroad instructions.

4. *Procedure.*—Continued.

Step 2. Dismantling.

Valves classified as scrap should be dismantled so that usable parts may be retained for future use.

Valves classified for repairs or salvage should be delivered to work bench and dismantled to the extent necessary to make repairs.

Step 3. Repairs.

Dismantled parts should be given a visual inspection and worn or damaged parts should be replaced.

All usable parts should be carefully cleaned and replated as required, care being taken that the electrical insulations are not subjected to any cleaning solution which might affect the dielectric qualities or cause subsequent electrolytic action between dissimilar metals.

The resistance of all coils should be checked to make certain that they conform to the requirements.

Armatures and pins, and the cylinders, should be checked to make certain that any wear is within tolerance limits.

Individual valves should be ground and seated, after which no interchange of parts shall be made.

Step 4. Assembly.

Valve unit should be reassembled using original parts where possible, making certain that the parts have been checked previously and found satisfactory for reuse.

Armature air gaps of magnets should be checked to see that they are uniform and in accordance with instructions. Make certain that the armature stroke is correct and that there is no binding of the valve stem.

It should be determined that replacement parts do not alter the characteristics of the valve except for intended improvements.

Wiring should be checked to make certain it is in good condition and all connections are mechanically and electrically sound.

When valve is equipped with cover gasket, the gasket should be checked to make certain it is in good condition and if not, it should be replaced.

Step 5. Testing.

Visual inspection should be made to make certain that valve is completely assembled, that all parts are secured in place, and proper clearances are provided.

Valve should be tested to determine that electrical operating values are within requirements and that it is free of air leaks.

Dielectric check of the completely assembled valve should be made to determine that requirements are met.

Valve should be given a final inspection to make certain that it is properly assembled, that all parts are in good condition and that no detail of assembly or test has been overlooked.

4. *Procedure.*—Continued.

Step 6. Preparing for shipment.

Necessary records should be made and completed valve tagged or marked as instructed.

Valve should be packed in an approved container for shipment. Container should be marked plainly to indicate that special care in handling is required.

Action Recommended

Acceptance as information.

SHOP PRACTICES FOR REPAIR OF SWITCH
CIRCUIT CONTROLLER SHAFTS*1. *Organization.*

(a) The number of switch circuit controller shafts to be repaired may not require a full-time assignment to this class of work. After the approximate number to be handled has been established and the average time per shaft has been determined, the force should be set up to take care of the requirements.

(b) The personnel should be trained in the repair of circuit controller shafts.

(c) Instructions and specifications for repairing should be provided.

(d) Instructions for determining which shafts are to be repaired should be provided. (In the preparation of these instructions, see "Salvaging or Repairing of Signal Material," AAR Signal Section 1952 Proceedings, Vol. L, p. 59.)

2. *Shop space.*

(a) Repair section should be of sufficient size to provide adequate work space for the force required. It should be clean, ventilated and well lighted, with work benches arranged at a comfortable height.

3. *Equipment.*

(a) The following equipment should be provided, as required:

1. Lathe.
2. Clean dry air supply with small hand blow gun.
3. Precision grinder.
4. Grinding wheels.
5. Necessary gages.
6. Vat for cleaning solution.
7. Welding or metal spraying equipment.
8. Work benches, storage racks and bins.

4. *Procedure.*Step 1. *Inspection.*

Visual inspection should be made for classification of repair, salvage or scrap. Shafts to be repaired or salvaged should be placed in classified storage.

Step 2. *Dismantling and repairing.*

Shafts should be cleaned and carefully checked for defects.

Shafts should be placed in lathe properly chucked and centered, and defective bearing surface should be undercut as instructed.

Bonding material where required should be applied to the undercut shaft.

Guards should be placed on the shaft to prevent molten metal from being deposited where not required in welding or spraying operation.

Apply molten metal or sleeve to prepared surface.

* The term "as instructed" as used herein refers to individual railroad instructions.

Procedure.—Continued.

Shaft should be placed in precision grinding machine or lathe as required for removal of excess material and finished to specifications.

Step 3. Testing.

Visual inspection and micrometer readings should be taken to determine that completed shaft is in accordance with specifications.

Step 4. Preparation for storage.

Exterior surfaces should be protected as instructed.

Reconditioned shaft to be returned to classified storage for future assembly.

Action Recommended

Acceptance as information.

SHOP PRACTICES FOR REPAIR OF SWITCH
POINT ROLLER BEARINGS*1. *Organization.*

(a) The number of roller bearings to be repaired may not require a full-time assignment to this class of work. After the approximate number to be repaired has been established and the average time per bearing has been determined, the force should be set up to take care of the requirements.

(b) The personnel should be trained in the repair and test of switch point roller bearings.

(c) Instructions and specifications for repairing and adjusting should be provided.

(d) Instructions for determining which bearings are to be repaired should be provided. (In the preparation of these instructions, see "Salvaging or Repairing of Signal Material," AAR Signal Section 1952 Proceedings, Vol. L, p. 59.)

2. *Shop space.*

(a) Repair section should be of sufficient size to provide adequate work space for the force required. It should be clean, ventilated and well lighted, with work benches arranged at a comfortable height.

3. *Equipment.*

(a) The following equipment should be provided, as required:

1. Lathe.
2. Hand tools including socket wrenches and gages.
3. Necessary machine tools.
4. Clean dry air supply with small hand blow gun.
5. Arbor press.
6. Precision grinder.
7. Grinding wheels.
8. Vat for cleaning solution.
9. Reamer.
10. Work benches, storage racks and bins.

4. *Procedure.*Step 1. *Inspection.*

Visual inspection should be made for classification of repair, salvage or scrap. Bearings to be repaired or salvaged should be placed in storage.

Step 2. *Dismantling and repairing.*

Bearings classified as scrap should be dismantled so that discarded parts can be placed in classified scrap.

Bearings classified for repair or salvage should be delivered to work bench and dismantled as indicated by repair classification.

* The term "as instructed" as used herein refers to individual railroad instructions.

4. Procedure.—Continued.

Dismantled parts should be given a visual inspection and worn or damaged parts set aside for repairs or replacement.

All usable parts should be carefully cleaned. They should be repaired as required.

Cut steel tubing of proper size for new shell of roller bearing. Place steel tubing in lathe and properly center for reaming inside diameter suitable for installing cup. Press cup into bearing shell until properly positioned.

Cut steel bar stock to proper length to form bearing shaft. Place bar stock in lathe properly centered for turning to specification size, threading and drilling.

Shaft to be placed in precision grinder for surfacing in accordance with specifications.

All oil and grease passages should be checked to make certain that they are open and free from obstructions.

Bearing assemblies should be cleaned and carefully checked for defects.

Bearing surfaces should be checked to see that they are within the tolerance limits. They should be lubricated as required.

Step 3. Assembly.

Bearings should be reassembled using parts which have been checked previously as properly formed and free from excessive wear, burrs or pits. The assembly should be adjusted for proper alignment and free movement of the bearing.

Step 4. Testing.

Visual inspection should be made to ascertain that bearing is properly lubricated, correct cotter pins are properly installed, lubrication fittings in place, and that all parts are securely fastened, with proper clearances.

Step 5. Preparation for shipment.

After assembly and test, exterior surface should be protected as instructed.

Bearings should be given a final inspection to make certain they are properly assembled, cleaned and protected as instructed.

Necessary records should be made and completed assembly tagged or marked, as instructed, and properly packaged to protect against damage in handling.

Action Recommended

Acceptance as information.

COMMITTEE IV—AUTOMATIC BLOCK SIGNALING

Personnel

F. L. Chatten, Chairman

W. L. Waleen, Vice-Chairman

B. M. Durland	J. A. Phillips
D. Furman	M. R. Roberts
J. A. Harvey	L. B. Sinclair
J. R. Heisler	H. G. Stiebeling
H. Jensen	D. H. Walkington
P. H. Lindereth	R. E. Wall
C. D. MacMillan	P. R. Whited
A. P. Young	

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Report on protection against lightning.
4. Investigate and report on methods of improving shunting of track circuits.
5. Investigate and report on means and methods for the improvement of track circuit rail bonding used in signaling.
8. Performance specification for solderless type connectors for use in wiring signal apparatus (various size conductors).
9. Requisites for surge protector for low-voltage apparatus.
11. Investigate and report on the effects of continuous rail on insulated joints.
12. Investigate and if found desirable prepare specifications for automatic type rectifiers.

The committee submits for consideration, report on the following subject*:

8. Requisites for Solderless Type Wire Terminals for Use in Wiring Signal Apparatus.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee IV at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Specification 151-58—Plug Type Rail Web Bonds and Track Circuit Connectors—Now in Manual Part 112.

AAR Sig. Sec. 1631F—Single Conductor Plug Type Rail Bonds and Track Circuit Connectors—Now in Drawing Section of Manual.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

Oct. 1959]

Com. IV—Automatic Block Signaling

AAR Sig. Sec. 1632F—Duplex Conductor Plug Type Rail Bonds and Track Circuit Connectors—Now in Drawing Section of Manual.

Specification 83-58—Transformer, Dry-Type, Self-Cooled—Now in Manual Part 164.

Specification 84-58—Transformer, Oil-Immersed, Self-Cooled—Now in Manual Part 165.

AAR SIGNAL SECTION REQUISITES.

SOLDERLESS TYPE WIRE TERMINALS FOR
USE IN WIRING SIGNAL APPARATUS

1959

1. These requisites are for the purpose of setting forth the recommended general requirements for solderless type wire terminals used in wiring signal apparatus on wire sizes from No. 22 to No. 4. They set forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing installations when general renewal or replacement becomes desirable.

2. Terminals shall be of two essential types, insulated and non-insulated.

3. Conductor insulation should be supported and gripped by the terminal where practical.

4. Terminals shall be capable of being applied to the conductor with tools recommended by the Manufacturer, to provide mechanical security and electrical performance, as required. Crimping tool must provide for full crimping cycle before permitting the crimping jaws to return to the original open position.

5. The current-carrying portions of terminals shall be of copper or suitable copper alloy to meet prescribed tests.

6. Terminals shall be coated with tin, nickel or silver plating, or equivalent. Cadmium or zinc shall not be used. Coating shall be of a quality and thickness to withstand tests specified without exposing the base metal.

7. All terminals of the insulated type shall have the outer surface of the wire barrel covered with insulation. The insulation shall extend over the wire barrel to a point not more than $\frac{3}{16}$ in. from the assembly of binding post, nut and washer for terminals on No. 22 to No. 10 wire nor more than $\frac{3}{16}$ in. on terminals for No. 8 to No. 4 wire; the insulation shall not foul the assembly and shall extend a sufficient distance beyond the barrel and over the conductor insulation to meet the prescribed tests.

8. Insulation shall be of a quality and thickness to withstand prescribed tests and shall remain in crimped position when exposed to a temperature of 185 deg. F.

9. The insulation material shall be non-corrosive, resistant to abrasion and fungi, shall not support combustion, and shall be capable of being crimped at temperatures of 5 deg. F. to 120 deg. F. without altering its characteristics.

10. Each terminal shall be properly identified for conductor size range and Manufacturer's identification.

11. Terminals shall meet the following requirements when attached to the conductor size for which they are designed and when crimped with tools recommended by Manufacturer:

(a) General.

1. All tests shall be made at room temperature unless otherwise specified and the test area shall be free from drafts. Terminals under overload and temperature tests shall be securely bolted back to back and suspended in free air with a minimum clearance of 18 in. Insulation supports, where provided, shall be closed on the conductor insulation for all the tests outlined hereinafter.

(b) Temperature rise.

1. Test currents as specified in Table I shall be conducted through the conductor and attached terminals continuously until the temperature is stabilized. The normal temperature rise shall not exceed 9 deg. F. above that of the cable to which it is connected. Temperature rise shall be measured at the barrel of each terminal by means of a thermocouple. The temperature of the conductor shall be measured by thermocouples embedded in the conductor strands at a minimum distance of 36 in. from the terminals and from the power source.

(c) Current overload.

1. Immediately following the temperature rise test and with the temperature stabilized at the normal load current specified in Table I, overload tests of 125 per cent test current for 2 hours and 200 per cent test current for 5 minutes shall be applied in this order and temperature rise measurements made at the conclusion of each period. The temperature rise shall not be more than 18 deg. F. above that of the conductor to which it has been connected.

(d) Resistance.

1. The resistance of the conductor connection in the terminal barrel shall be determined from the voltage drop measured between the intersection of the tongue and barrel of the connector and a point on the conductor $\frac{1}{8}$ in. minimum from end of insulation support. The voltage drop shall not exceed the initial values specified in Table I.

(e) Corrosion.

1. Terminal assemblies as used for resistance test shall be maintained in a salt fog chamber in a horizontal position in accordance with Federal Specification QQ-M-151, Method 41, for 100 hours, arranged to be separated by at least $\frac{1}{4}$ in. and shall not come in contact with metallic or wooden objects so that the salt fog shall have free access to the samples. Following this test, the samples shall be subjected to the specified resistance tests and the voltage drop of the samples shall not exceed the "After Test" values specified in Table I. Corrosion on the terminal tongue should be removed with fine sandpaper for the resistance tests.

(f) Vibration.

1. Terminals shall be attached to a 12-inch length of conductor and mounted on binding post conforming to Drawing 1070, on a vibration table with the free end of the conductor secured to a stable support. The terminals shall then be vibrated for 18 hours on each of two perpendiculars displaced 90 deg. to the axis of the conductor at a total amplitude of $\frac{1}{16}$ in. at a cycling frequency of 10 to 55 to 10 cycles per second. This cycling frequency to be accomplished in 1 minute. After

this test, the terminals shall pass the specified tests for resistance and tensile strength.

(g) Tensile strength.

1. The mechanical connection of the conductor and terminal shall not break when subjected to the tensile load specified in Table I. Strain shall be applied at the rate of 1 in. per minute.

(h) Dielectric strength for insulated terminals.

1. The terminal insulation shall be wrapped with a thin, conductive foil firmly pressed into and around the crimped surface of the barrel. The foil may extend back along the conductor insulation but shall be far enough away from the terminal tongue to prevent flashovers. A test voltage of 60 cycles per second shall be applied between the terminal tongue and the foil and shall be increased from 0 to 1,000 volts (r.m.s.) within $\frac{1}{2}$ minute and maintained at that figure for a period of 1 minute. No breakdown of the insulation shall be evident within that time. Flashovers below the minimum dielectric strength shall be cause for retest but not rejection.

TABLE I

Conductor, size	Test- current, amperes	(Max. voltage drop) milli-volts		Tensile load (min.), lbs.
		Initial	After test	
22	9	8	13	15
20	11	7	12	19
18	16	7	12	38
16	22	7	12	50
14	32	6	11	70
12	41	5	8	110
10	55	5	8	180
8	73	5	8	225
6	101	5	8	300
4	135	5	8	400

Action Recommended

Acceptance for submission to letter ballot.

COMMITTEE V—CONTRACTS AND INSTRUCTIONS

Personnel

F. Youngwerth, Chairman

J. G. Karlet, Vice-Chairman

G. D. Booth

A. T. Hunot

L. C. Brown

C. H. Johnson

F. R. Cummings

J. E. Johnson

D. E. Firestone

W. C. McConnell

O. C. French

V. F. Rathje

E. L. Rogers

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
4. Instructions for testing and locating crosses and grounds on signal circuits and apparatus.
6. Specification for instruments for testing and locating crosses and grounds.

The committee submits for consideration, reports on the following subjects*:

1. Revision of Instructions for Track Circuits, Manual Part 8.
4. Instructions for Locating Crosses and Grounds.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee V at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Instructions for Impedance Bonds—Now in Manual Part 210.

Instructions for Insulation Resistance Testing—Now in Manual Part 130.

Instructions for Light and Semaphore Signals—Now in Manual Part 54.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

AAR SIGNAL SECTION INSTRUCTIONS.

LOCATING CROSSES AND GROUNDS

1959

These instructions apply to the locating of crosses and grounds in open line wires or cables. They set forth general requirements representing recommended practice.

General.

1. Tests which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs, when required, must be made in such manner that the safety of train operation will not be impaired. When repair, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment

2. Electrostatic capacitance should be discharged by shorting the circuit, or by grounding the conductor, before and after making a test to avoid receiving a shock or damaging the apparatus.

3. Grounded or crossed conductors must be disconnected from apparatus before starting tests.

Instruments.

4. Direct reading, Wheatstone bridge, West portable test set or similar instrument should be used.

5. Test leads, as required for insulation resistance testing, should be used and must be tested before using in accordance with Instructions for Insulation Resistance Testing, Manual Part 130.

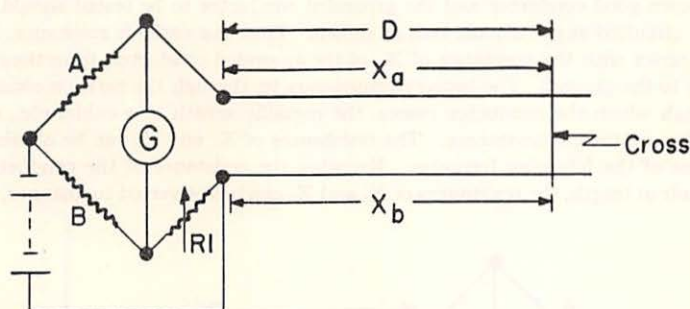
6. Direct reading instruments must be connected and operated in accordance with manufacturer's instructions.

7. West portable test set must be connected and operated in accordance with AAR Communications Section Specification 2-J-16, or manufacturer's instructions.

8. Wheatstone bridge or similar type instrument may be connected to the conductor or conductors to form a Simple loop, Varley loop, Murray loop, Fisher loop or Moody loop, and must be operated in accordance with manufacturer's instructions.

Locating a cross.

9. Knowing the resistance of the conductors per 1,000 feet, or other unit of length, the location of a "dead cross" (zero resistance cross) may be found with a Simple loop test or resistance measurement as shown in Fig. 1. The resistance as measured is the resistance of the conductors from the test point to the cross.

Locating a cross.—Continued.Fig. 1.
Simple Loop.

Where $A = B$

and $R_1 =$ Rheostat reading

$r_a =$ resistance per unit of length of conductor a

$r_b =$ resistance per unit of length of conductor b

$D =$ unknown distance to cross

$X_a = Dr_a$ and $X_b = Dr_b$

Then $R_1 = X_a + X_b$ or $D(r_a + r_b)$

and $D = \frac{R_1}{r_a + r_b}$ in same units of length as for r_a and r_b

Note—Where conductors are same gage

$$r_a = r_b$$

and

$$D = \frac{R_1}{2r_a}$$

10. If the cross appears to have other than zero resistance, two measurements as described in Instruction 9 are required to determine if the resistance is zero. Make one measurement with the distant end of the conductors open and one measurement with the distant ends short circuited. If the two measurements are the same the cross is known to have zero resistance. If the resistance measurement with the distant end of the pair short circuited is lower in value than the measurement with the distant end of the pair open, the cross itself has some resistance. If the cross is found to have other than zero resistance its location can be found by making loop measurements from each end of the pair and calculating an imaginary location from each measurement on the assumption of a zero resistance cross. The actual location of the cross will be at the mean, or midpoint between the two imaginary locations.

Locating a ground.

11. The Varley loop test is best adapted to the locating of a ground in a conductor. The most commonly used test circuit is shown in Fig. 2. For best re-

Locating a ground.—Continued.

sults the values of A and B should be equal, or the ratio kept as low as possible. A known good conductor and the grounded conductor to be tested should be short circuited at the distant end, as shown. Then the variable resistance, R_1 , is in series with the resistance of X_a of the grounded conductor, from the test point to the ground. The battery return may be through the earth, a conduit through which the conductor passes, the metallic sheath of a cable, etc., depending on the circumstances. The resistances of X_a and X_b can be obtained by one of the following formulas. Knowing the resistance of the conductors per unit of length, the resistances of X_a and X_b can be converted to distance.

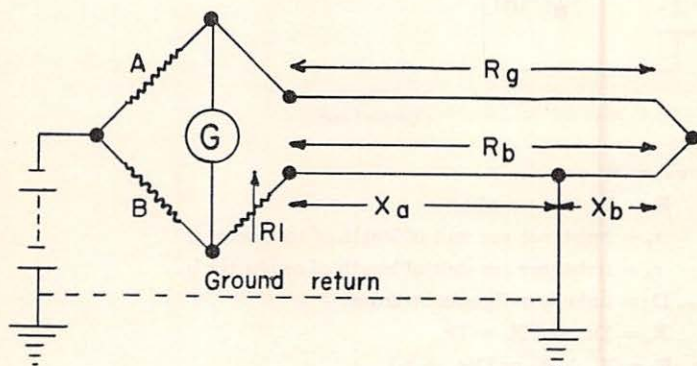


Fig. 2.
Varley Loop.

Where R_g = calculated resistance of a good conductor

R_b = calculated resistance of the grounded conductor

X_a = resistance of grounded conductor from test point to the ground

X_b = resistance from point of ground to connection with good conductor

$$\text{then } \frac{A}{B} = \frac{R_g + X_b}{R_1 + X_a}$$

$$\text{Since } X_b = R_b - X_a$$

$$\text{then } \frac{A}{B} = \frac{R_g + R_b - X_a}{R_1 + X_a}$$

$$\text{and } X_a = \frac{B(R_g + R_b) - AR_1}{A + B}$$

$$\text{and where } A = B \text{ or } \frac{A}{B} = 1$$

$$\text{then } X_a = \frac{R_g + R_b - R_1}{2}$$

$$\text{and } X_b = R_b - X_a$$

For a check, interchange the good and the grounded or faulty conductor at the test instrument, as in Fig. 3.

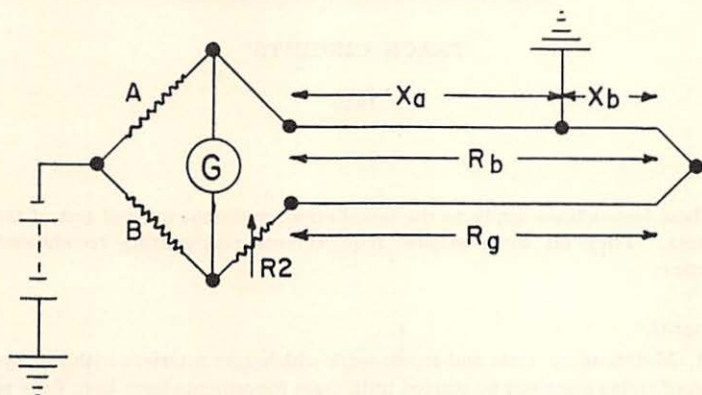
Locating a ground.—Continued.

Fig. 3.
Varley Loop (check).

Where R_2 is the value of the rheostat at balance

$$\frac{A}{B} = \frac{X_a}{R_2 + R_g + X_b}$$

since $X_b = R_b - X_a$

$$\frac{A}{B} = \frac{X_a}{R_2 + R_g + R_b - X_a}$$

and
$$X_a = \frac{A(R_2 + R_g + R_b)}{A + B}$$

Where $A = B$ or $\frac{A}{B} = 1$

then
$$X_a = \frac{R_2 + R_g + R_b}{2}$$

and
$$X_b = R_b - X_a$$

12. Instructions for using the Simple loop, Varley loop and other test loops will be found in manufacturer's operating manuals.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of Instructions for Track Circuits)
AAR SIGNAL SECTION INSTRUCTIONS.

TRACK CIRCUITS*

1959

These instructions apply to the installation, maintenance and test of track circuits. They set forth general requirements representing recommended practice.

General.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. The length of any section of a track circuit, except trap circuit or special circuit not used for control of signaling facilities, must be maintained greater than maximum inner wheel base of any engine or car.

3. Dead sections must be maintained not to exceed 35 ft. unless special circuit is used. Where shortest outer wheel base of an engine or car operating over any dead section is less than 35 feet, the maximum length of the dead section must not exceed the length of the outer wheel base of such engine or car unless special circuit is used.

4. Bonding must be installed and maintained in condition to insure low resistance. Bolts in angle bars should be kept tight.

5. Bonding must be inspected as instructed and renewed as required.

6. Each wire must be tagged or otherwise marked so it can be identified at each terminal. Nomenclature must correspond to that of the circuit plan. Tags or other marks of identification in instrument cases and apparatus housings must be made of insulating material. Wires, tags, or other markings must not interfere with moving parts of apparatus.

7. Parts which fail to perform their intended functions must be promptly adjusted, repaired or replaced.

8. When track or other conditions are such that they may cause signal interruption or unsatisfactory operation of signal apparatus, the section foreman, or whoever is immediately responsible for such conditions, must be requested to remedy the condition. If such request is not acted upon within a reasonable time, the matter must be reported to proper authority in writing.

9. Shunt wires and fouling wires, except shunt wires to switch circuit controller through which signal control circuits are controlled and track circuits

* The term "as instructed" as used herein refers to individual railroad instructions.

General.—Continued.

are shunted, must consist of at least two conductors and each must be of sufficient conductivity and maintained in such condition that the track relay will be in de-energized position when the circuit is shunted.

10. Fouling section of turnout must be so maintained that it will extend to clearance point or beyond, as instructed.

11. Track relay must be in de-energized position whenever any of the following conditions exist, and the track circuit of an automatic train stop, train control, or cab signal system must be de-energized in the rear of the point where any of the following conditions exist:

(a) When a rail is broken or a rail or switch frog is removed except when a break occurs within the limits of the rail joint bars or bonds, or when a rail is broken or removed in the shunt fouling circuit of a turnout or crossover, provided, however, that shunt fouling circuit may not be used in a turnout through which permissible speed is greater than 45 miles per hour.

(b) When a train, engine, or car occupies any part of a track circuit, including fouling section of turnout or crossover, except turnouts of a hand-operated main track crossover protected by other means than track circuits.

(c) Where switch shunting circuit is used:

1. Switch point is not closed in normal position.

2. A switch is not locked where facing point lock with circuit controller is used.

3. An independently operated fouling point derail equipped with switch circuit controller is not in derailing position.

12. Where practicable, top of rails should be kept free from sand, rust, dirt, or other foreign matter that prevents effective shunting of track circuit.

13. Track circuit connectors and connections must be maintained in good condition.

14. Pipe lines under rail must clear base of rail at least 1 inch.

15. Lightning arresters and made grounds must be properly connected, maintained and tested as instructed.

16. Ballast resistance should be kept as high as possible by keeping ballast free from rail and rail fastenings and providing proper drainage. Broken track spikes must not be driven through ties.

17. Resistance of ballast should preferably be not less than 2 ohms per 1,000 feet of track.

18. When making train shunt resistance test it should be made in accordance with Form 7003, Manual Part 196.

19. Shunting sensitivity test of a track circuit should be made by determining the maximum resistance that can be placed across the rails opposite the relay and opposite the source of energy to cause the relay to assume its de-energized position.

(a) Where track circuits include turnouts or crossovers, additional shunting sensitivity tests must be made at the following locations:

1. Turnouts.

(a) Switch point side of insulated joints in lead rails and at each end of fouling circuit.

General.—Continued.

2. Crossovers.

(a) Switch point side of insulated joints in lead rails and both sides of insulated joints at center of crossover.

(b) Where center insulated joints are not used, make tests at locations specified in Instruction 19-a-1.

(b) If the shunt resistance is less than 0.06 ohm, corrective measures must be taken at once.

20. Shunting tests must be made during dry weather conditions when the maximum current is flowing through the relay coils.

21. Where biased relays or two-element two-position a.c. relays are used, polarities of adjacent track circuits should be staggered, where possible. In other types of track circuits the polarities of adjacent circuits may be staggered as instructed.

22. Switch circuit controllers must be maintained and tested in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

23. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

24. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

25. Ground resistance must be maintained and tests made in accordance with Instructions for Made Grounds, Manual Part 61.

26. Unauthorized experiments or alterations in track circuits must not be made.

27. Any unusual occurrences or developments in track circuits must be promptly reported to proper authority.

28. Results of inspections and tests herein required and all other inspections and tests that may be required must be recorded as instructed.

Direct current track circuits.

29. Track circuits must be so adjusted that proper working current will flow through the coils of the relay during minimum ballast resistance conditions.

30. With an 0.06-ohm shunt applied, as instructed, tests must be made during maximum ballast resistance conditions and with normal voltage for the type of battery used to determine that the current through the coils of the relay is:

(a) For non-coded d.c. track circuits, less than the minimum drop-away current or field requirement as established by instructions for the particular relay installed.

(b) For coded d.c. track circuits, less than the minimum pick-up or field requirement as established by the instructions for the particular relay installed.

(c) For non-coded d.c. track circuits using 2 and 4-ohm relays, not more than 30 milliamperes for 2-ohm relays or 20 milliamperes for 4-ohm relays having iron magnetic structure, and not more than 40 milliamperes for 2-ohm relays or 27 milliamperes for 4-ohm relays having silicon steel magnetic structures.

Direct current track circuits.—Continued.

31. The minimum limiting resistance allowable in series with the track battery must be maintained, as instructed, for the type of relay and battery used.

(a) For track circuits having 2 and 4-ohm relays, resistance between battery and rails must be not less than that shown in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

32. The resistance in series with track relay, where used, must be maintained as instructed.

33. When relayed cut-section is used in territory where non-coded direct current track circuits are in use, the energy circuit to the adjoining track circuit must be open and the track circuit shunted when the track relay at such cut-section is in de-energized position.

34. At grade crossing with an electric road where foreign current is present, the electric energy for non-coded direct current track circuit must feed away from the crossing.

35. Where foreign current is present, follow Instructions for Minimizing the Effect of Foreign Current on Direct Current Track Circuits, Manual Part 127.

36. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

37. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

38. Cells and batteries must be maintained and tested in accordance with Instructions for Cells and Batteries, Manual Parts 7 and 14.

39. Rectifiers and motor-generators must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

Non-coded alternating current track circuits.

40. Voltage at the relay local terminals must be as near as possible the normal voltage given on the manufacturer's tag or name plate. If less than the normal voltage value is impressed across the local terminals, more energy will have to be used in the track element to cause proper operation, except for centrifugal frequency relays. While a reduction in the local voltage of a centrifugal frequency relay generally does not require additional energy to the track element, this reduction in the local voltage should be avoided as it tends to increase the time of shunting.

41. For single-element relays, the voltage at the relay track terminals under wet ballast or other adverse conditions must be at least 10 per cent higher than the values given on the manufacturer's tag or name plate to take care of varying ballast conditions and bonding. For two-element relays, the voltage on the relay track terminals under wet ballast or other adverse conditions must be 10 per cent higher than that necessary to energize the relay with normal front contact compression. On account of varying phase angle conditions the necessary voltage on the track element may be considerably in excess of the values marked on the manufacturer's tag or name plate. A check for the proper voltage to be applied across the track terminals of a relay under wet or other un-

Non-coded alternating current track circuits.—Continued.

favorable conditions, is to shunt the relay so that its contacts open halfway, then remove the shunt, and if the contacts come up to the front stop, sufficient energy is passing through the track windings.

42. When shunting two-element track relays, shunt must be applied at the terminals of the track element and not the local element.

43. On non-electrified road track circuits, the voltage on the rails at transformer end should be approximately one-half that at the transformer secondary under minimum ballast resistance conditions, or as instructed. Where reactive transformers are in use, the transformer secondary voltage is the no-load secondary voltage.

44. To obtain adequate broken-rail detection on electric road track circuits, it may be necessary to make adjustments so that under the minimum ballast resistance conditions the voltage at the rails opposite the transformer is approximately two-thirds that of the transformer secondary voltage. Where reactive transformers are in use, the voltage on the rails at the transformer end should be approximately two-thirds the open circuit transformer voltage.

45. To obtain the best operation of two-element track relays under adverse ballast conditions, phase measuring instruments should be used to determine that the phase angle relations in the relay approach the ideal value. These measurements may indicate that adjustments should be made to improve phase relations.

46. To obtain broken-rail detection on electric road track circuit, it is desirable that cross-bonds between neutral connections of impedance bonds on parallel tracks or between a neutral connection and a negative propulsion return cable should not be located closer than at alternate impedance bond locations. Calculations should be made and checked by field tests under the most adverse conditions so that the cross-bonding as installed does not interfere with the desired broken-rail detection.

47. Both rails of a double-rail electric road track circuit should be equally well bonded because defective bonding in one rail will cause an unbalanced condition of the track circuit due to unequal amounts of return propulsion current in the two rails.

(a) With direct current propulsion and double-rail track circuits, unbalanced propulsion current may saturate the iron core of the impedance bonds. This may lower the bond impedance to such a point that the track relay may be shunted.

(b) With alternating current propulsion and double-rail track circuits, unbalanced propulsion current will cause the impedance bond to act as an auto-transformer. Since the track relay is connected in multiple with the bond, the auto-transformer voltage may cause sufficient alternating current of propulsion frequency to flow in the relay to cause it to open its contacts, or to blow the protective fuse.

48. Where single-rail track circuits are used on electric roads, care must be taken to adjust the resistors at the relay and transformer ends so that the amount of propulsion current permitted to flow through the relay track winding is less than the allowable amount specified for a given relay. Where heavy direct current propulsion is present, a shielding or a balancing impedance may also be installed in connection with the track relay to protect against direct current in the relay windings.

Non-coded alternating current track circuits.—Continued.

49. The current limiting device used in the transformer track lead should be a reactor if possible, as the losses in a reactor are less than in a resistor. A resistor in place of a reactor should be used only when required to give correct phase relations in two-element track relays or to protect the relay and transformer from direct current propulsion return current.

50. Alternating current track circuit tests must be made in accordance with A.C. Track Circuit Characteristics, Manual Part 161.

51. Relays must be maintained and tested in accordance with Instructions for Alternating Current Relays, Manual Part 124.

52. Impedance bonds, where used, must be installed, maintained and tested in accordance with Instructions for Impedance Bonds, Manual Part 210.

53. Fuses must be inspected as instructed and replaced in kind when necessary.

54. To measure the current the relay is receiving from the track circuit, measure first the voltage across the relay track terminals, then insert an ammeter in the track leads and again measure the terminal voltage. This voltage divided by the current gives the impedance of the relay which corresponds to the resistance of a direct current relay. Divide the relay terminal voltage, read with the ammeter removed, by the impedance. The result obtained will be the relay current.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Track Circuits, Manual Part 8.

COMMITTEE VI—DESIGNS

Personnel

C. J. R. Taylor, Chairman

R. L. Bush, Vice-Chairman

H. Alexander	W. R. Parker
R. I. Becksted	J. M. Stanfill
C. H. Gilbert	D. B. Thomas
J. W. Kunker	C. H. Tobin
W. T. Lewis	W. J. Varner
J. C. Lummis	A. J. Yarrell

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Designs.
 - (a) Plug-in type terminal posts and connectors.
 - (c) Piers for instrument housings.
 - (i) Highway crossing signal, flashing light type, 6 ft. and longer, cantilever or bridge span assemblies, utilizing improved construction methods and materials for supporting structures, collaborating with Committee VIII.
 - (j) Extruded section reflectorized aluminum crossbuck.
 - (k) Climbing steps as a substitute for ladder on wayside and flashing light signals.
5. Simplification of sizes and kinds of electric lamps for signal purposes, collaborating with Purchases and Stores Division, AAR.
6. Investigate and report on means and methods for the improvement of incandescent electric lamps used in signaling.

The committee submits for consideration, reports on the following subjects*:

1. Revised drawings.
 - Drawing to be made obsolete.
 - Revision of Specifications for Bolts, Nuts and Threads, Manual Part 17.
 - Revision of Specification 51-58, Manual Part 91.
 - Revision of Specification 155-51, Manual Part 44.
 - Revision of Specification 69-48, Manual Part 136.
3. New drawings.
5. See revision of Specification 51-58, Manual Part 91.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

Information

Specifications, etc., of other organizations referred to in the report of this committee may be procured from the following:

American Standard—American Standards Association, 70 E. 45th St., New York 17, N. Y.

ASTM—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee VI at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

AAR Sig. Sec. 1491F—Highway Crossing Gate Roadway Arm for Mast Mounted Gate Mechanism—Now in Drawing Section of Manual.

AAR Sig. Sec. 1492C—Highway Crossing Gate Sidewalk Arm for Mast Mounted Gate Mechanism—Now in Drawing Section of Manual.

AAR Sig. Sec. 1493B—Highway Crossing Gate Roadway Arm for Pedestal Mounting—Now in Drawing Section of Manual.

AAR Sig. Sec. 1494B—Highway Crossing Gate Sidewalk Arm for Pedestal Mounting—Now in Drawing Section of Manual.

AAR Sig. Sec. 1505C—Falling Rock Detector—Details and Assembly—Now in Drawing Section of Manual.

AAR Sig. Sec. 1506B—Rock Slide Detector—Details and Assembly—Now in Drawing Section of Manual.

AAR Sig. Sec. 1634C—Insulated Joint Location—Automatic Signals and Interlocking—Now in Drawing Section of Manual.

Drawing 1176—Trunking—Grooved Type—Obsolete—Removed from Drawing Section of Manual.

Drawing 1177—Trunking—Built-up Type—Obsolete—Removed from Drawing Section of Manual.

RSA 1232—Mechanical Dwarf Signal Top and Base Bearings (Details)—Obsolete—Removed from Drawing Section of Manual.

AAR Sig. Sec. 1233B—Mechanical Dwarf Signal Spectacles and Lamp Bracket Support—Details and Assembly—Obsolete—Removed from Drawing Section of Manual.

AAR Sig. Sec. 1239B—Mechanical Dwarf Signal Fittings—Details—Obsolete—Removed from Drawing Section of Manual.

AAR Sig. Sec. 1567B—Mechanical Dwarf Signal—Details—Obsolete—Removed from Drawing Section of Manual.

ARA Sig. Sec. 1568A—Mechanical Dwarf Signal—Details—Obsolete—Removed from Drawing Section of Manual.

AAR Sig. Sec. 1270A—Insulated Rod for Switch Circuit Controller—Details and Assembly—Now in Drawing Section of Manual.

AAR Sig. Sec. 1290A—Begin TCS Sign—End TCS Sign—Sheet Metal Type for 4 to 8-Inch Pipe—Details and Assembly—Now in Drawing Section of Manual.

- AAR Sig. Sec. 1330A—Switch Obstruction Gages—Details and Assembly—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1520A—Steel Battery Box—Small Size—Assembly—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1521A—Steel Battery Box—Small Size—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1522A—Steel Battery Box—Large Size—Assembly—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1523A—Steel Battery Box—Large Size—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1524A—Steel Battery Box—Details and Assemblies—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1525A—Steel Battery Box—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1526A—Steel Battery Box—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1527A—Steel Battery Box—Details and Assemblies—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1560A—Precast Concrete Foundation for 5 and 6-Inch Masts—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1561A—Precast Concrete Foundation for 8-Inch Mast—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1579A—Precast Concrete Foundation for 10 and 12-Inch Masts—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1580A—Precast Concrete Foundations—Assemblies—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1723A—Articulated Highway Crossing Gate Arm—Assembly—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1724A—Articulated Highway Crossing Gate Arm—Details—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1725A—Articulated Highway Crossing Gate Arm—Details—Now in Drawing Section of Manual.
- Specification 51-58—Incandescent Electric Lamps—Now in Manual Part 91.
- Specification 137-39—Oil Lighted Lamp—Obsolete—Removed from Manual Part 204.

REVISED DRAWINGS

AAR Sig. Sec. 1271C—Ball Studs for Switch Circuit Controller—Details and Assemblies.

Note added restricting detail 12717 for replacement use. Assembly 12712 revised to show ball stud 12713 with castellated nut replacing ball stud 12717 and jam nut. Footnote reference to specifications revised and reference to specifications for steel added. This revision reduces the number of types of studs required to be carried in stock from two to one.

AAR Sig. Sec. 1399E—Low Target Stand—Details and Assembly.

Revised to show new items details 13998 and 13999. Reference to C1020 steel removed. Footnote reference to specifications revised and reference to specifications for steel added.

AAR Sig. Sec. 1442C—Lens Hoods and Couplings for Switch and Semaphore Lamps.

Plain lug 14425 added. Notes for sheet steel modified to agree with standard practice. Footnote reference to Specifications for Bolts, Nuts and Threads, and steel, added.

AAR Sig. Sec. 1543B—Incandescent Electric Lamps—Filaments.

Completely revised and redrawn. The numerical order of the views of filaments rearranged. Secondary filament of C-2R main filament lamp changed to permit C-6 or CC-6 SF. Filaments S-3, C-2F and C-17 added and 2C-5, C-8 and C-13 removed. Alternate for filament C-6 shown as CC-6.

AAR Sig. Sec. 1647F—Single Adapter Clamp for Signs—4 to 8 Inch Pipe—Details.

Removed detailed view of 16473 strap and 16475 bolt. Added details of 16478 washer and reference for standard bolt complete 16479. Removed "after threads have been cut" from note. Footnote references to specifications revised.

AAR Sig. Sec. 1702C—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details.

Detail 16473 removed and details of steel strap added. Footnote reference to specifications for steel for strap added.

AAR Sig. Sec. 1703C—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details.

Detail 16473 removed and details of steel strap added. Footnote reference to specifications for steel for strap added.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

AAR Sig. Sec. 1271B—Ball Studs for Switch Circuit Controller—Details and Assemblies.

AAR Sig. Sec. 1399D—Low Target Stand—Details and Assembly.

ARA Sig. Sec. 1442B—Lens Hoods and Couplings for Switch and Semaphore Lamps.

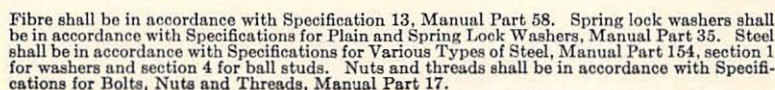
AAR Sig. Sec. 1543A—Incandescent Electric Lamps—Filaments.

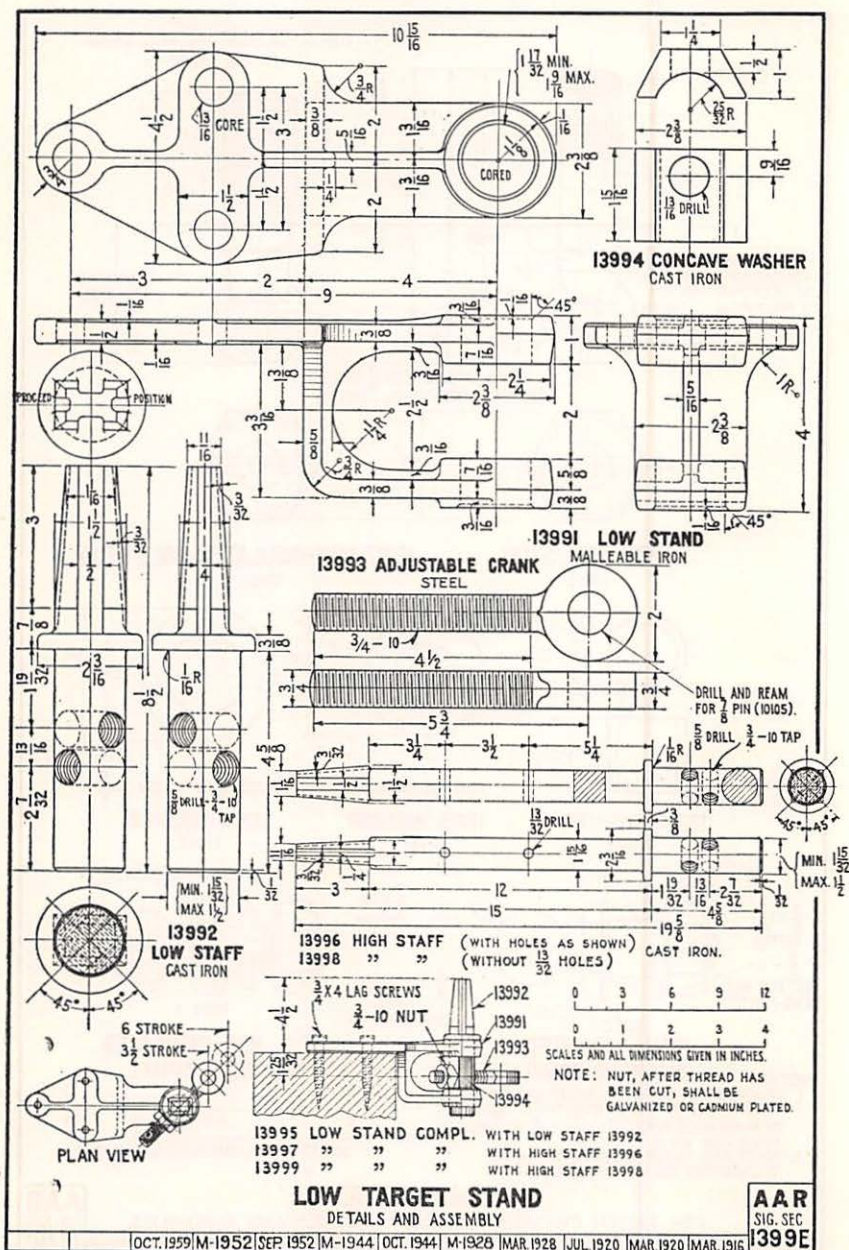
AAR Sig. Sec. 1647E—Single Adapter Clamp for Signs—4 to 8 Inch Pipe—Details.

AAR Sig. Sec. 1702B—Front and Back Plates for Stop on Red Signal Sign—Reflector Unit Type—Details.

AAR Sig. Sec. 1703B—Front and Back Plates for Stop When Swinging Sign—Reflector Unit Type—Details.

Oct. 1959]

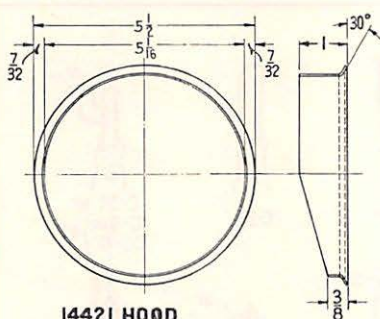




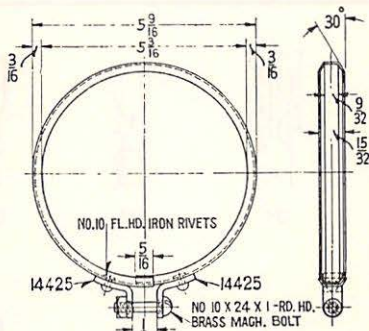
Cast iron shall be Class 20 in accordance with Specification for Gray Iron Castings, Manual Part 88. Malleable iron shall be Grade 32510 in accordance with Specification for Malleable Iron Castings, Manual Part 89. Nut and thread shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Painting shall be in accordance with Instructions for Painting, Manual Part 110. Steel shall be in accordance with Specifications for Various Types of Steel, Manual Part 154, section 1.

AAR
SIG. SEC
1399E

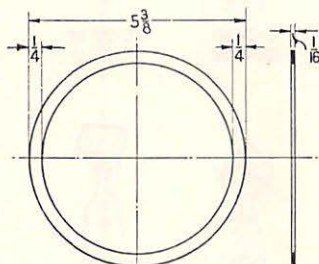
Oct. 1959]



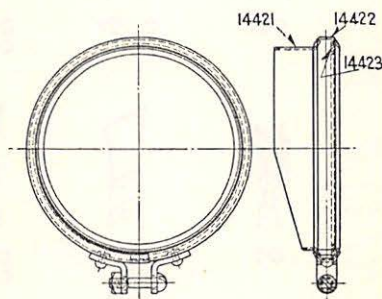
I4421 HOOD
NO. 18 GAGE (0.0478) SHEET STEEL



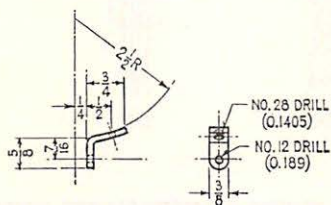
I4422 COUPLING RING
NO. 25 GAGE (0.0209) SHEET STEEL



I4423 GASKET
RUBBER



I4424 HOOD COMPL. WITH COUPLING AND GASKET



I4425 PLAIN LUG
NO. 11 GAGE (0.1196) STEEL

0 1 2 3 4 5 6
SCALE AND ALL DIMENSIONS ARE GIVEN IN INCHES

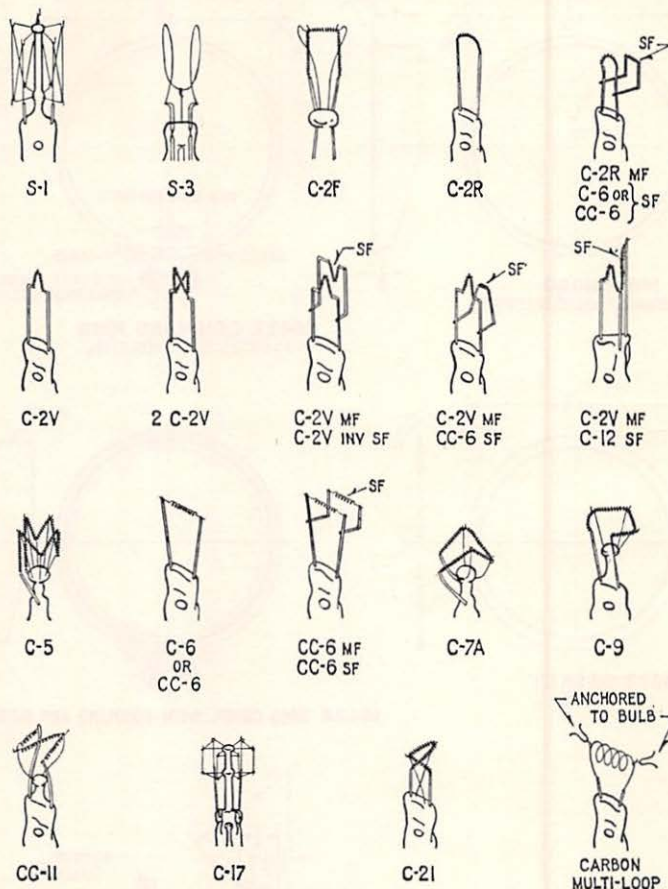
LENS HOODS AND COUPLINGS FOR SWITCH AND SEMAPHORE LAMPS

AAR
SIG. SEC.

I442C

OCT. 1959 | M-1926 | SEP. 1925 | MAN. 1920 | MAR. 1920

Bolt, nut and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Steel shall be in accordance with Specifications for Various Types of Steel, Manual Part 154, or stainless steel.



NOTE: THE MOUNTING OF TUNGSTEN FILAMENTS IS DESIGNATED BY AN IDENTIFICATION PREFIX LETTER, A NUMBER AND SOMETIMES A SUFFIX LETTER. THE PREFIX LETTER INDICATES WHETHER THE FILAMENT IS STRAIGHT WIRE (S), COILED (C), OR COILED COIL (CC). THE NUMBER INDICATES THE FORM OR ARRANGEMENT OF THE FILAMENT ON THE SUPPORTS. C-2 SUFFIX "R" INDICATES ROUNDED FORM AND "V" INDICATES "V" SHAPE. TWO IDENTICAL FILAMENTS IN MULTIPLE HAVE A PREFIX "2", THUS 2 C-2V. THE LETTERS "MF" INDICATE MAJOR FILAMENT, AND "SF" SECONDARY FILAMENT.

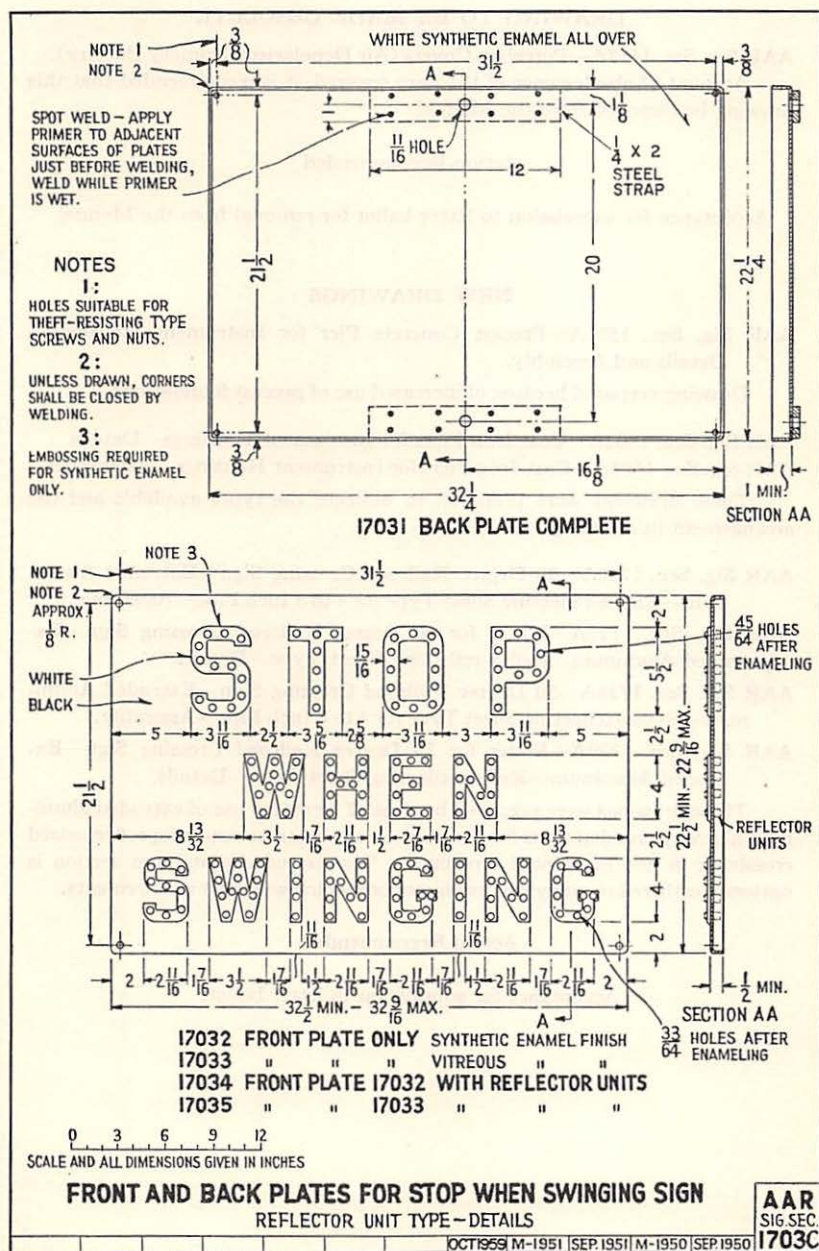
INCANDESCENT ELECTRIC LAMPS

FILAMENTS

OCT. 1959 | M-1941 | SEP. 1941

AAR
SIG. SEC.
1543B

Oct. 1959]



Material and painting shall be in accordance with Specifications 155 and 156, Manual Parts 44 and 43. Steel strap shall be in accordance with Specifications for Various Types of Steel, Manual Part 154.

DRAWING TO BE MADE OBSOLETE

AAR Sig. Sec. 1417A—Porcelain Covers (Air Depolarized Primary Battery).

Account of obsolescence of the item covered, it is recommended that this drawing be removed from the Manual.

Action Recommended

Acceptance for submission to letter ballot for removal from the Manual.

NEW DRAWINGS

AAR Sig. Sec. 1581A—Precast Concrete Pier for Instrument Housings—Details and Assembly.

Drawing prepared because of increased use of precast foundations.

AAR Sig. Sec. 1603A—Cast-Iron Piers for Instrument Housings—Details.

AAR Sig. Sec. 1604A—Cast-Iron Piers for Instrument Housings—Assemblies.

These drawings were prepared to indicate the types available and the arrangement in assembly.

AAR Sig. Sec. 1726A—90 Degree Railroad Crossing Sign—Extruded Aluminum—Reflex-reflecting Sheet Type for 4 to 8 Inch Pipe—Assembly.

AAR Sig. Sec. 1727A—Plates for 90 Degree Railroad Crossing Sign—Extruded Aluminum—Reflex-reflecting Sheet Type—Details.

AAR Sig. Sec. 1728A—50 Degree Railroad Crossing Sign—Extruded Aluminum—Reflex-reflecting Sheet Type for 4 to 8 Inch Pipe—Assembly.

AAR Sig. Sec. 1729A—Plates for 50 Degree Railroad Crossing Sign—Extruded Aluminum—Reflex-reflecting Sheet Type—Details.

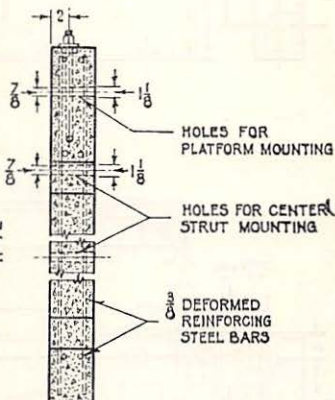
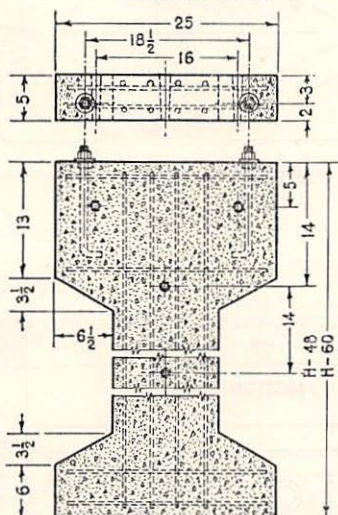
These drawings were prepared because of increased use of extruded aluminum highway crossing signs for use at crossings in states requiring reflectorized crossbuck in lieu of painted crossbuck. The extruded aluminum section is optional as there are many extrusion sections which will meet requirements.

Action Recommended

Acceptance for submission to letter ballot.



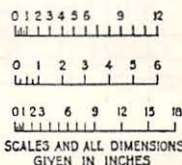
ANCHOR BOLTS



15811	CONCRETE PIER COMPLETE WITH ANCHOR BOLT ASSEMBLY	15815	SPECIFY HEIGHT H
15812	" " " " " "	15816	" " "
15813	" " " " " "	15817	" " "
15814	" " " " " " INSERT ASSEMBLY	15818	" " "

NOTES: 1. REINFORCEMENT SHALL BE PLACED NOT LESS THAN ONE INCH FROM OUTSIDE SURFACES.

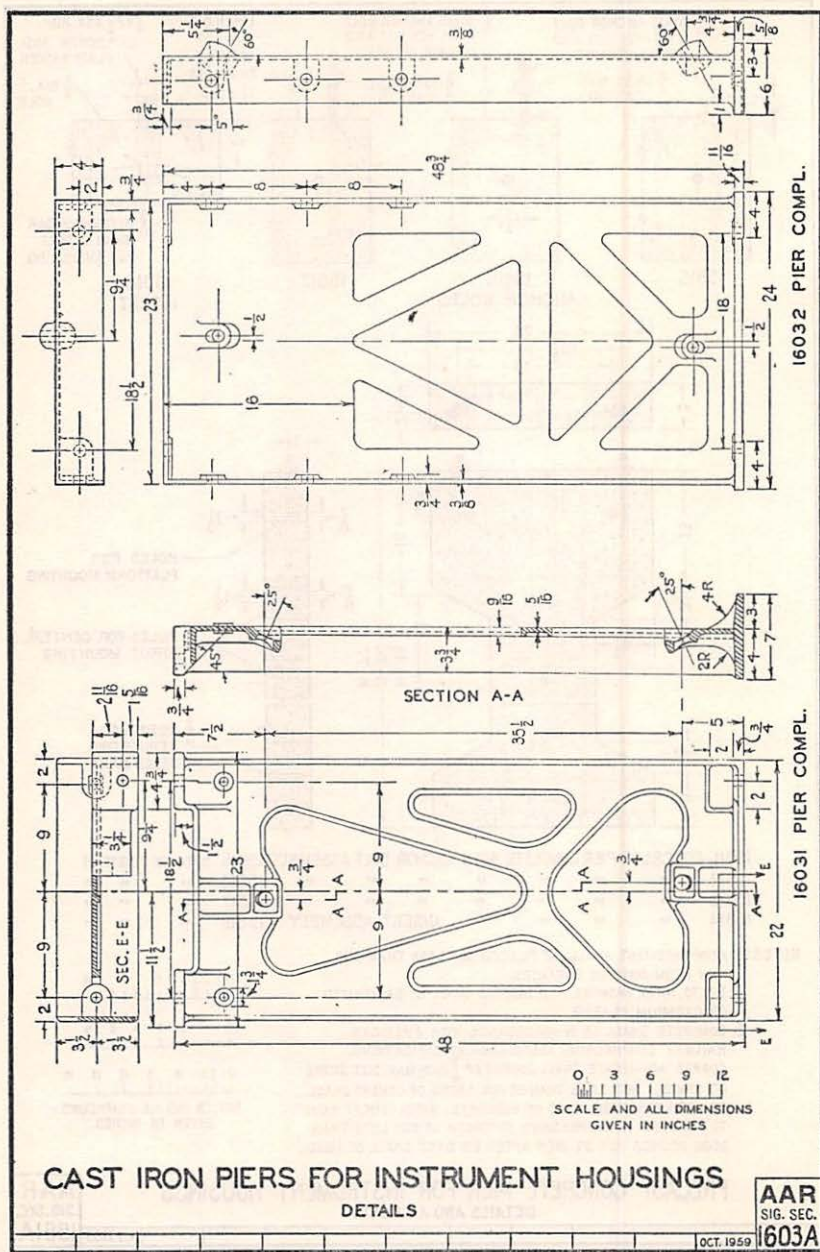
2. BOLTS, NUTS, WASHERS, AND INSERTS SHALL BE GALVANIZED OR CADMIUM PLATED.
3. CONCRETE SHALL BE IN ACCORDANCE WITH AMERICAN RAILWAY ENGINEERING ASSOCIATION SPECIFICATIONS. COARSE AGGREGATE SHALL CONSIST OF $\frac{3}{4}$ INCH MAX. SIZE STONE OR GRAVEL. NOT LESS THAN SEVEN SACKS OF CEMENT SHALL BE USED PER CUBIC YARD OF CONCRETE. WATER CEMENT RATIO TO PRODUCE A COMPRESSIVE STRENGTH OF NOT LESS THAN 3000 POUNDS PER SQ. INCH AFTER 28 DAYS SHALL BE USED.

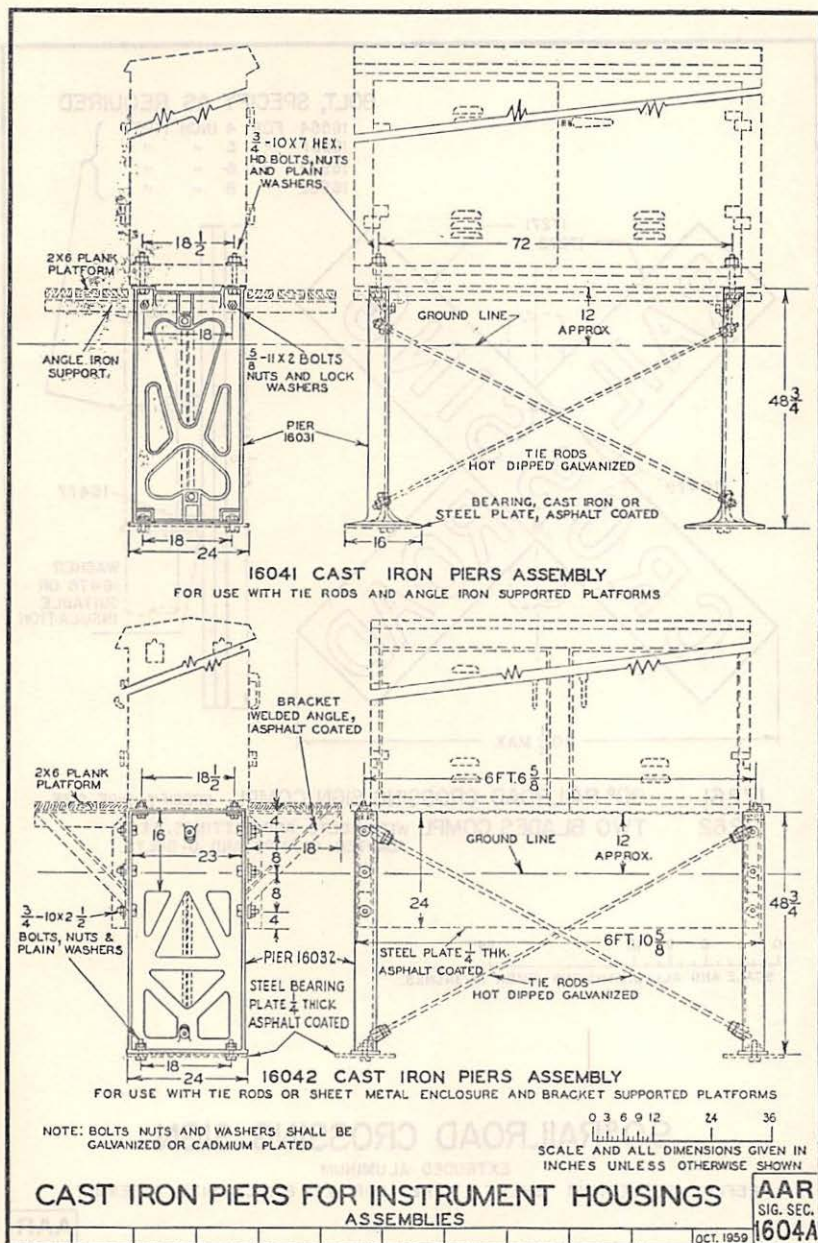


PRECAST CONCRETE PIER FOR INSTRUMENT HOUSINGS

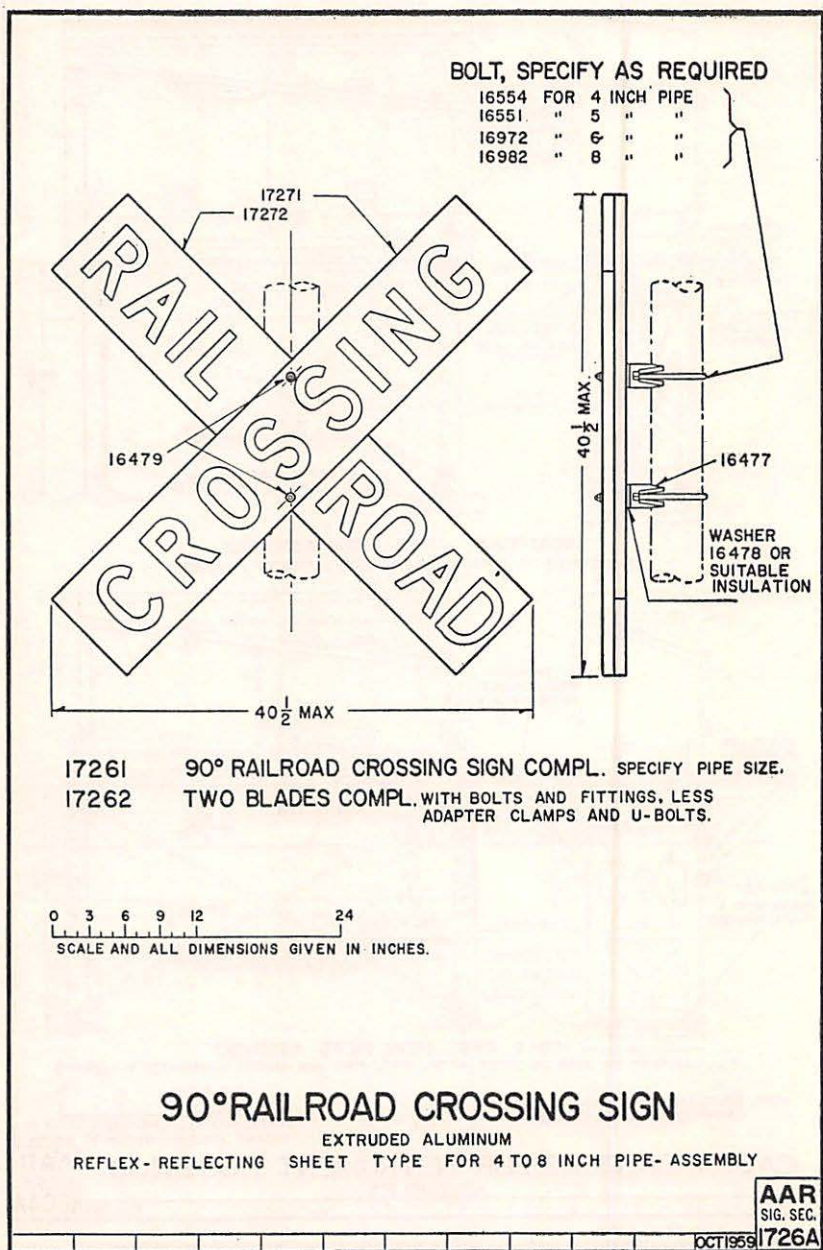
AAR
SIG.SEC.
1581A

Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Washers shall be in accordance with Specifications for Plain and Spring Lock Washers, Manual Part 35.

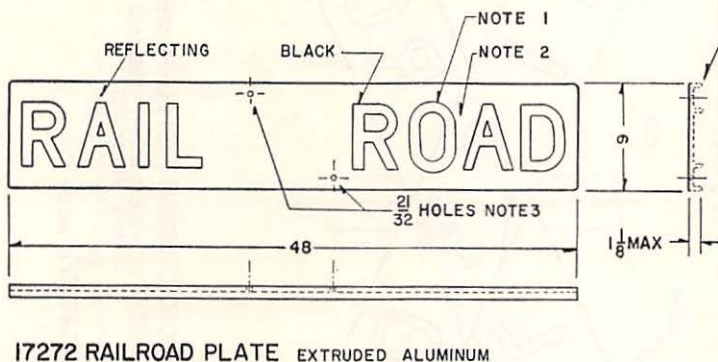
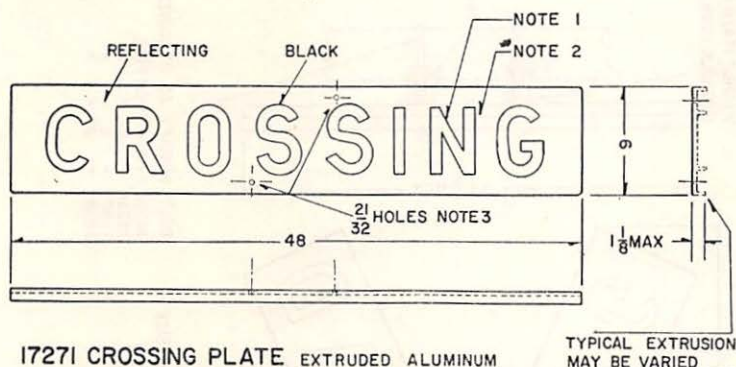




Steel for plate shall be in accordance with Specifications for Various Types of Steel, Manual Part 154, section 1. Steel for rods shall be in accordance with Specifications for Various Types of Steel, Manual Part 154, section 2 or 6. Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17. Spring lock washers shall be in accordance with Specifications for Plain and Spring Lock Washers, Manual Part 35. Painting shall be in accordance with Instructions for Painting, Manual Part 110.



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



NOTES:

1. SEE 1712 FOR DETAILS.
2. SEE 1706 FOR SPACING.
3. SPACING AS REQUIRED BY EXTRUSION.

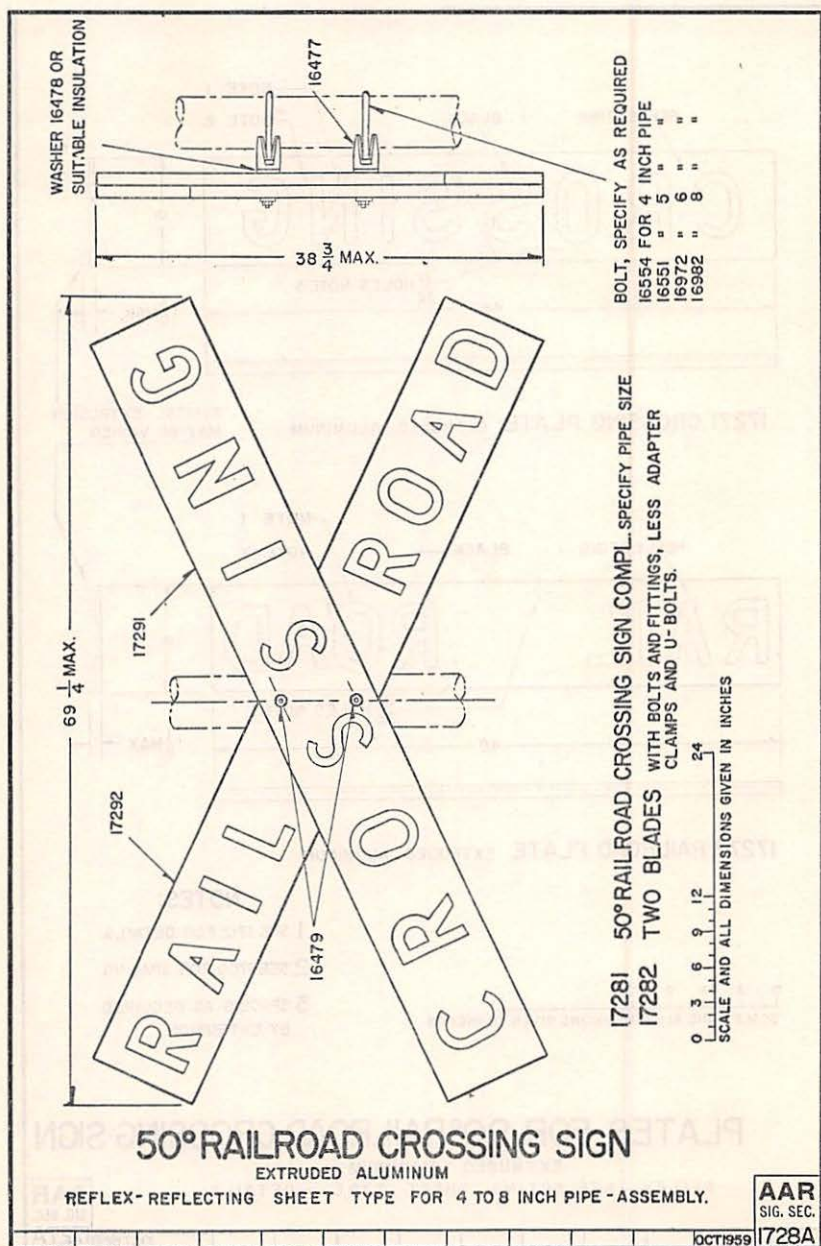
0 3 6 9 12
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

PLATES FOR 90°RAILROAD CROSSING SIGN

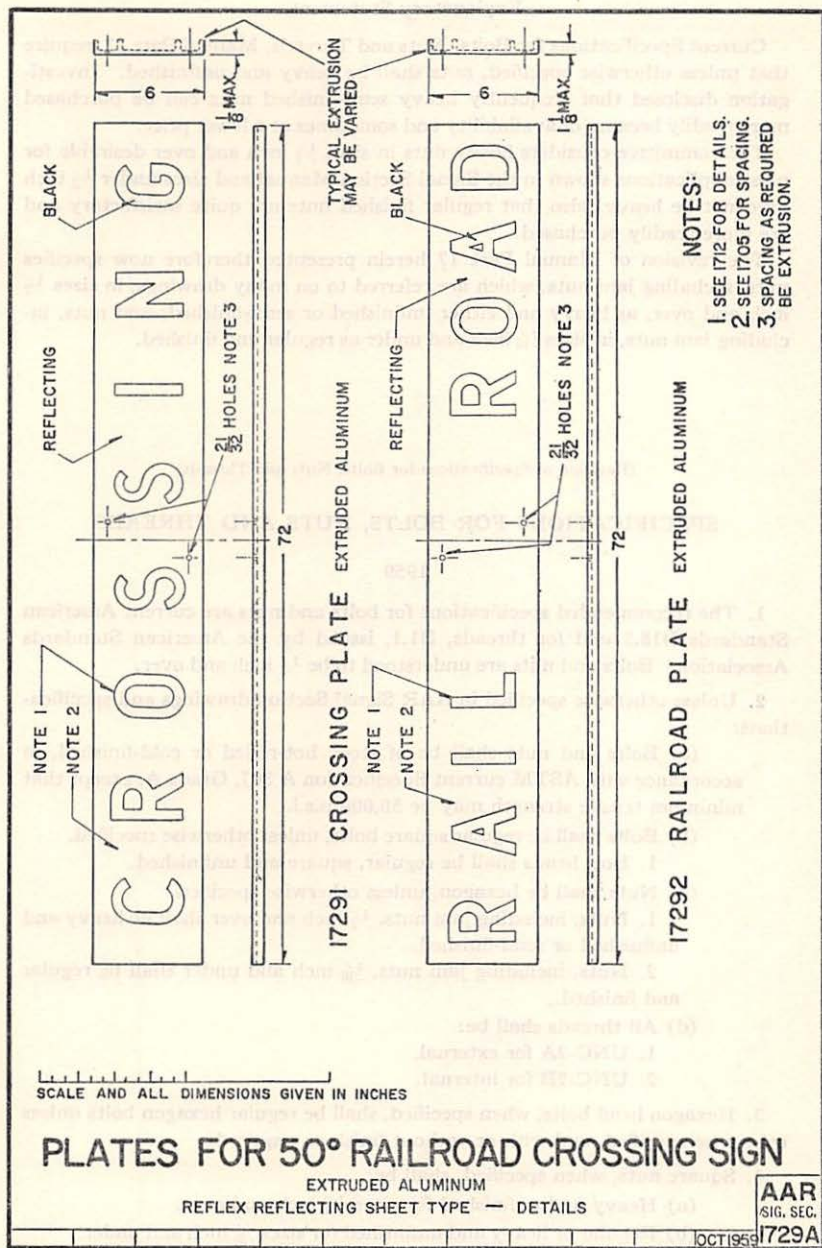
EXTRUDED ALUMINUM
REFLEX - REFLECTING SHEET TYPE - DETAILS

AAR
SIG. SEC.
1727A

OCT 1959



Bolts, nuts and threads shall be in accordance with Specifications for Bolts, Nuts and Threads, Manual Part 17.



Material, painting and construction shall be in accordance with Specification 155, Manual Part 44.

Explanatory Statement

Current Specifications for Bolts, Nuts and Threads, Manual Part 17, require that unless otherwise specified, nuts shall be heavy and unfinished. Investigation disclosed that frequently heavy semi-finished nuts can be purchased more readily because of availability and sometimes at a lower price.

The committee considers heavy nuts in sizes $\frac{1}{2}$ inch and over desirable for most applications shown in the Signal Section Manual and sizes under $\frac{1}{2}$ inch need not be heavy; also that regular finished nuts are quite satisfactory and are more readily purchased.

The revision of Manual Part 17 herein presented therefore now specifies nuts, including jam nuts, which are referred to on many drawings, in sizes $\frac{1}{2}$ inch and over, as heavy and either unfinished or semi-finished; and nuts, including jam nuts, in sizes $\frac{1}{16}$ inch and under as regular and finished.

(Revision of Specifications for Bolts, Nuts and Threads)

SPECIFICATIONS FOR BOLTS, NUTS AND THREADS

1959

1. The recommended specifications for bolts and nuts are current American Standards B18.2 and for threads, B1.1, issued by the American Standards Association. Bolts and nuts are understood to be $\frac{1}{4}$ inch and over.

2. Unless otherwise specified in AAR Signal Section drawings and specifications:

(a) Bolts and nuts shall be of steel, hot-rolled or cold-finished, in accordance with ASTM current Specification A 307, Grade A, except that minimum tensile strength may be 50,000 p.s.i.

(b) Bolts shall be regular square bolts, unless otherwise specified.

1. Bolt heads shall be regular, square and unfinished.

(c) Nuts shall be hexagon, unless otherwise specified.

1. Nuts, including jam nuts, $\frac{1}{2}$ inch and over shall be heavy and unfinished or semi-finished.

2. Nuts, including jam nuts, $\frac{1}{16}$ inch and under shall be regular and finished.

(d) All threads shall be:

1. UNC-2A for external.

2. UNC-2B for internal.

3. Hexagon head bolts, when specified, shall be regular hexagon bolts unless otherwise specified, and with or without finish as required.

4. Square nuts, when specified, shall be:

(a) Heavy and unfinished for sizes $\frac{1}{2}$ inch and over.

(b) Regular or heavy and unfinished for sizes $\frac{1}{16}$ inch and under.

5. Galvanizing or cadmium plating, when required, shall be in accordance with Specifications for Metallic Coating of Metals, Manual Part 63, and shall be applied after threads have been formed.

6. External threads specified with rounded roots shall be in accordance with permissible limits specified in current American Standard B1.1.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specifications for Bolts, Nuts and Threads, Manual Part 17.

(Revision of AAR Signal Section Specification 51-58)
AAR SIGNAL SECTION SPECIFICATION 51-59.

INCANDESCENT ELECTRIC LAMPS

Review of Specification 51-58 indicated revisions required in various sections, to keep the specification in conformance with manufacturers' current practice and to eliminate reference to voltage ranges for the circuit volts shown in Tables V and VII and in place thereof to show the specific voltage applying. The following proposed revisions are therefore presented:

8. *Bulb and stem.*

(c) Color coating shall be translucent and shall not change color, or peel with heat, or chip in handling.

9. *Base.*

(a) The material for SPECIAL TYPE lamps shall be good quality brass.

12. *Identification.*

(a) Each lamp shall be plainly marked with rating or trade number and Manufacturer's name or trade-mark, on the bulb or base where space permits.

16. *Acceptance requirements.*

(c) Manufacturer's declared efficiency.

1. Manufacturer shall declare for each lot of lamps furnished under these specifications, the initial efficiency at which the lamps are to be appraised for compliance with rating and life requirements. The declared efficiency shall be not more than 2 per cent below the lumens-per-watt (large lamps), nor more than 4 per cent below the candles-per-watt (miniature lamps) value shown in Tables VII and VIII, Schedule of Commercial Ratings. For the purpose of maintaining the rated life given in the schedule, the efficiency of any size of lamp may be changed by notice from Manufacturer, provided the preceding stipulation is complied with.

16. *Acceptance requirements.*—Continued.

(d) Rejection for spread in rating.

1. Test lamps shall be operated at rated volts or amperes. A lot of lamps may be rejected if 20 per cent plus 2 lamps (30 per cent plus 2 lamps when tested elsewhere than at the factory) or more of the test lamps depart from Manufacturer's declared initial rating by more than the tolerance specified in Tables V and VI, Initial Rating Tolerances. Individual test lamps may be rejected and eliminated from an accepted lot if they fall outside these tolerances by more than an additional 4 per cent for large lamps and 8 per cent for miniature lamps.

TABLE V
Initial Rating Tolerances (Miniature Lamps)

Manufacturer's designation No.	Base	Rated spherical candlepower	Circuit volts	Bulb	Initial rating tolerances at design volts			
					Variation in candles per watt, plus or minus	Variation in spherical candlepower, plus or minus	Variation in amperes, plus or minus	Multiplying factor for basic life tolerances
					Per cent	Per cent	Per cent	
67	SC	4	12	G-6	12	15	8	2.0
68	DC	4	12	G-6	12	15	8	2.0
87	SC	15	6	S-8	7	9	5	1.0
89	SC	6	12	G-6	12	15	8	1.5
1141	SC	21	12	S-8	9	10	6	1.0
63K	S. Can.	*3	6	G-6	6	8	5	1.5
67K	S. Can.	*4	12	G-6	12	15	8	2.0

* The candlepower is nominal.

(See page 111 for revised Table VII)

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Like sections and tables of Specification 51-58, Manual Part 91.

16. Acceptance requirements.—Continued.

TABLE VII
Schedule of Commercial Ratings (Miniature Lamps)

Manufacturer's designation No.	Base	Circuit, volts	Design, amperes	Rated spherical candle-power	Bulb	Maximum over-all length, inches	Light center length, inches	Design, volts	Candle-power maintenance at 4/5 life*, % of initial	Initial candles (spherical), per watt	Rated average laboratory life, hours
67	SC	12	0.59	4	G-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.50	84	0.67	
68	DC	12	0.59	4	G-6	$1\frac{7}{16}$	$1\frac{3}{16}$	13.50	84	0.67	
87	SC	6	1.91	15	S-8	2	$1\frac{1}{8}$	6.75	90	1.16	300
89	SC	12	0.58	6	G-6	$1\frac{7}{16}$	$\frac{3}{4}$	13.00	82	0.80	750
1141	SC	12	1.34	21	S-8	2	$1\frac{1}{4}$	12.80	80	1.22	500
63K	S. Can.	6	0.63	†3	G-6	$1\frac{3}{8}$	$1\frac{5}{16}$	7.00	91	0.73	1,000
67K	S. Can.	12	0.41	†4	G-6	$1\frac{3}{8}$	1	13.50	83	0.67	1,000

* These maintenance values apply to base horizontal burning.

† The candlepower is nominal.

(Revision of AAR Signal Section Specification 155-51)
AAR SIGNAL SECTION SPECIFICATION 155-59.

RAILROAD-HIGHWAY GRADE CROSSING SIGNS

1. *Purpose.*

(a) This specification is for the purpose of providing signs of various designs for railroad-highway grade crossing protection. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement become desirable.

2. *Specifications and drawings.*

(a) Specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturers shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on the Purchaser's order:

1. Specific detail part references as shown on drawings for:

(a) Cast-metal type, iron or aluminum.

(b) Reflector unit type.

(c) Reflex-reflecting sheet type.

1. Flat single plate, steel or aluminum.

2. Extruded section, aluminum.

(d) Vitreous enamel finish for front plate.

(e) Synthetic enamel finish for front plate.

(f) Numeral for number of tracks.

2. Drawing reference details as required for 90 deg. Railroad Crossing signs:

(a) Cast-iron type—details and assembly—Drawing 1640.

(b) Reflector type—assembly—Drawing 1642.

(c) Reflector unit type, front plates, iron or steel—details—Drawing 1643.

(d) Back plates, iron or steel—details—Drawing 1701.

(e) Reflex-reflecting sheet type, flat plates, steel—assembly—Drawing 1717.

(f) Reflex-reflecting sheet type, flat plates, steel—details—Drawing 1718.

(g) Reflex-reflecting sheet type, extruded aluminum section—assembly—Drawing 1726.

4. *Purchaser's order requirements.*—Continued.

(h) Reflex-reflecting sheet type, extruded aluminum section—details—Drawing 1727.

3. Drawing reference details as required for 50 deg. Railroad Crossing signs:

(a) Reflector type—assembly—Drawing 1692.

(b) Reflector unit type, front plates, iron or steel—details—Drawing 1693.

(c) Back plates, iron or steel—Details—Drawing 1704.

(d) Reflex-reflecting sheet type, flat plates, steel—assembly—Drawing 1715.

(e) Reflex-reflecting sheet type, flat plates, steel—details—Drawing 1716.

(f) Reflex-reflecting sheet type, extruded aluminum section—assembly—Drawing 1728.

(g) Reflex-reflecting sheet type, extruded aluminum section—details—Drawing 1729.

4. Drawing reference details as required for Number of Tracks signs:

(a) Cast-iron type—details and assembly—Drawing 1644.

(b) Reflector type—assembly—Drawing 1645.

(c) Reflector unit type front and back plates—details—Drawing 1700.

(d) Reflex-reflecting sheet type, flat plate, steel—detail and assembly—Drawing 1719.

(e) Numerals—details—Drawing 1650.

5. Drawing reference details as required for Stop on Red Signal signs:

(a) Reflector type—assembly—Drawing 1646.

(b) Reflector unit type, front and back plates—details—Drawing 1702.

(c) Reflex-reflecting sheet type, flat plate, steel—detail and assembly—Drawing 1720.

6. Drawing reference details as required for Stop When Swinging signs:

(a) Reflector type—assembly—Drawing 1648.

(b) Reflector unit type, front and back plates—details—Drawing 1703.

(c) Reflex-reflecting sheet type, flat plate, steel—detail and assembly—Drawing 1721.

7. Drawing reference details as required for adapter clamps and bolts:

(a) Double adapter clamp and details for railroad crossing signs—Drawing 1641.

(b) Single adapter clamp for signs—4 to 8-inch pipe—details—Drawing 1647.

8. Inspection and tests as required.

9. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

(b) Unless specified otherwise on drawings, castings, extrusions and sheet metal shall be as follows:

1. Gray iron castings shall be in accordance with Specification for Gray Iron Castings, Manual Part 88, Class 20.

2. Aluminum castings shall be in accordance with ASTM current Specification B 26, alloy S5A.

3. Extruded aluminum shall be in accordance with ASTM current Specification B 221, alloy GS10A-T42, T5 or T6.

4. Sheet steel for parts having synthetic enamel finish shall be No. 16 U. S. Standard Gage (0.0625 in.) and in accordance with the following:

(a) The total amount of carbon, manganese, phosphorous, sulphur and silicon shall not exceed 0.70 per cent. If the total of these five elements equals or exceeds 0.20 per cent, the metal shall contain not less than 0.17 per cent copper and not more than 0.06 per cent sulphur. If the total of these five elements is less than 0.20 per cent and sulphur is not greater than 0.04 per cent, the presence of copper is optional.

(b) The base metal shall be uniformly coated on both sides of the sheet with a good quality of zinc applied either by the hot-dip or the electro-plating process. The zinc coating shall have a uniform dull matte surface for good adhesion of primer and shall meet the bending requirements of section 6-b-4-c. The surface of the finished sheets shall be free of any material that will be injurious to the primer, enamel or zinc coating. The weight of the zinc coating on the finished sheets shall be such as to meet a minimum requirement of 0.75 oz. per sq. ft. of sheet, as determined by the Diagonal Triple Spot Test specified in ASTM current Specification A 90.

(c) The material in the sheets shall be of such nature that the zinc coating shall adhere tightly to all parts of the sheet so that it will not peel or flake off from the outside surface of the bend when the sheet is bent around a 90 deg. angle with the sharp corner rounded to $\frac{1}{64}$ in. radius.

5. Sheet iron for parts having vitreous enamel finish shall be No. 16 U. S. Standard Gage (0.0625 in.) and of the grade known to the trade as "enameling stock." It shall be manufactured by some company recognized as producing a satis-

6. Material and workmanship.—Continued.

factory material of this type and shall be of such quality that will provide a high grade finished product. The following is a typical analysis of a satisfactory product:

Carbon.....	0.012 to 0.030 max.
Manganese.....	0.018 to 0.110 max.
Phosphorous.....	0.004 to 0.010 max.
Silicon.....	0.003 to 0.010 max.
Sulphur.....	0.023 to 0.045 max.

6. Sheet aluminum shall be in accordance with ASTM current Specification B 209, alloy GS11A-T6.

(c) Reflector units, where used, shall be in accordance with Specification 156, Manual Part 43, of proper diameter to fit $\frac{33}{64}$ in. holes for 4 in. letters and $\frac{45}{64}$ in. holes for $5\frac{1}{2}$ in. letters and numerals.

(d) Reflex-reflecting sheet material, where used, shall be in accordance with Specification 255, Manual Part 276.

7. Reflector unit assembly.

(a) Reflector units shall be held in a fixed relation to the aperture with their axes normal to the face of the sign.

(b) Reflector units shall be readily removable for replacement when the front plate is taken off. When mounted from the rear, they shall be held in position to facilitate assembly.

(c) Reflector units shall project not more than $\frac{3}{8}$ in. outside of aperture.

8. Front plates and back plates (box type).

(a) The front plate shall be attached to the back plate by bronze or stainless steel screws and nuts of theft-resisting type which cannot be removed with ordinary pliers, wrench, or screw driver.

9. Aluminum unit assembly.

(a) Cast-iron adapter clamps conforming to Drawings 1641 or 1647 shall be used to attach sign to mast. *R-9-a.

(b) The face of cast-iron adapter clamp shall be covered by a washer, Drawing 1647, detail 16478, or by other protective means to prevent electrolytic action between dissimilar metals.

(c) The unit assembly of sheet or extruded section should be attached to the adapter clamp by aluminum, galvanized or cadmium plated steel bolts, nuts and washers to prevent electrolytic action between dissimilar metals.

10. Welding.

(a) Support straps, where called for on box type plates or on flat plates shall be securely welded to the sheet metal by methods which will provide a firm bond without warpage. If spot welding

* Alternate requisites section.

10. *Welding.*—Continued.

is used it shall be applied at intervals no greater than $4\frac{1}{2}$ in., starting $\frac{5}{8}$ in. from each end. Prior to welding, the surface of the sheet metal and the strap shall be treated with a suitable primer paint and the welding done while primer is wet.

11. *Painting.*

(a) All metal surfaces shall be thoroughly cleaned in order to secure a suitable surface for painting.

(b) Paint used shall be in accordance with the following specifications:

1. Primer—Specification 201, Type III, Manual Part 65, or equivalent.
2. White—Specification 227, Manual Part 235.
3. Black—Specification 227, Manual Part 235.
4. Non-reflecting black—Specification 214, Manual Part 221.

(c) Cast-iron signs shall be painted as follows:

1. One coat of primer, in accordance with section 11-b-1, applied to all surfaces.
2. Two finish coats of white, in accordance with section 11-b-2, applied to all surfaces.
3. Two finish coats of black, in accordance with section 11-b-3, applied to letters and numerals, over the white coats.

(d) Sheet metal signs of reflector unit type, requiring synthetic enamel finish, shall be painted as follows:

1. Front plates.

(a) For Railroad Crossing signs.

1. One coat of primer, in accordance with section 11-b-1, applied to all surfaces.
2. Three finish coats of white, in accordance with section 11-b-2, applied to all surfaces.
3. Two finish coats of black, in accordance with section 11-b-3, applied to the letters, over the white coats.

(b) For signs other than Railroad Crossing.

1. One coat of primer, in accordance with section 11-b-1, applied to all surfaces.
2. Two finish coats of black, in accordance with section 11-b-3, applied to all surfaces.
3. One coat of non-reflecting black, in accordance with section 11-b-4, applied to front surface only.
4. Three finish coats of white, in accordance with section 11-b-2, applied to the letters and numerals, over the black coats.

2. Back plates.

- (a) One coat of primer, in accordance with section 11-b-1, applied to all surfaces.

11. *Painting.*—Continued.

- (b) Three finish coats of white, in accordance with section 11-b-2, applied to all surfaces.
- (c) Sheet metal signs of reflex-reflecting sheet type, steel, shall be painted as follows:
 - 1. Flat plate type.
 - (a) For Railroad Crossing signs.
 - 1. One coat of primer, in accordance with section 11-b-1, applied to all surfaces.
 - 2. Three finish coats of white, in accordance with section 11-b-2, applied to all surfaces.
 - (b) For signs other than Railroad Crossing.
 - 1. One coat of primer, in accordance with section 11-b-1, applied to all surfaces.
 - 2. Two finish coats of black, in accordance with section 11-b-3, on front surface and edges.
 - 3. One coat of non-reflecting black, in accordance with section 11-b-4, on front surface only.
 - 4. Three finish coats of white, in accordance with section 11-b-2, on back surface only.
- (f) Signs of reflex-reflecting type, aluminum sheet and extruded section.
 - 1. For Railroad Crossing signs.
 - (a) Such aluminum types need not be painted, but should be cleaned, and etched or coated with wash primer prior to application of reflex-reflective sheeting in accordance with Manufacturer's recommendations for applying such sheeting.
 - 2. For signs other than Railroad Crossing.
 - (a) One coat of wash primer.
 - (b) One coat of primer, in accordance with section 11-b-1, on front surface only.
 - (c) Two finish coats of black, in accordance with section 11-b-3, on front surface only.
 - (d) One coat of non-reflecting black, in accordance with section 11-b-4, on front surface only.
- (g) All letters and numerals shall be true as to edge and form, and holes for reflector units shall be evenly spaced with reference to the edges.

12. *Vitreous enamel finish.*

- (a) Prior to the application of the vitreous enamel coatings, the metal shall be thoroughly cleaned to free it of all foreign substances such as dirt, scale, and grease, by immersion in an acid bath followed by proper washing and neutralization.
- (b) After the piece has been properly pickled, a grip or ground coat shall be applied by spraying. This coat shall be applied to all parts of the piece—front, back, sides, and edges. When fused, the ground coat shall present a lustrous, continuous surface of vitreous enamel over all parts of the sign, of uniform thickness

12. *Vitreous enamel finish.*—Continued.

and free from blisters, copperheads, or other defects which would permit of access or contact of the atmosphere with the steel.

(c) Where white is called for on drawings it shall consist of two coats separately applied and fused. The final coat shall have architectural finish.

(d) Where black is called for it shall consist of two coats separately applied and fused. The final coat shall have architectural finish.

(e) The enamel application shall be as thin as practicable to insure a strong, tenacious covering which will be resistant against abrasion and chipping.

(f) Great care shall be exercised to prevent the formation of heavy enamel in the openings in the plate. All holes for reflector units shall be carefully wiped for a distance of $\frac{1}{8}$ in. around the edge of the hole in order to provide a uniform diameter and to prevent the accumulation of enamel around the hole edges.

(g) All letters and numerals shall be true as to edge and form, and holes for reflector units shall be evenly spaced with reference to the edges.

(h) Plates shall be free from objectionable warpage.

13. *Reflex-reflecting sheet finish.*

(a) Railroad Crossing signs.

1. Reflecting material shall be for background only as called for on drawings.

2. Prior to application of reflex-reflecting sheet, the signs shall have complete treatment in accordance with section 11 as required.

3. The reflex-reflecting sheet shall be in accordance with Specification 255, Manual Part 276, and shall be cut with square corners for application to the entire front surface of the front plate except for a space of approximately, but not less than, $\frac{1}{16}$ in. from the edges.

4. The adhesive backing shall be activated by the prescribed solvent or by heat, and the sheeting then applied by hand roller, squeeze roller or vacuum applicator to form a durable bond to the enamel finish and not closer than $\frac{1}{16}$ in. to any edge of plate.

5. Lettering conforming to drawing shall then be applied over the reflex sheeting, by use of pre-cut synthetic lettering film having adhesive backing, or by use of heavy black paste enamel applied with a silk screen process.

(b) Signs other than Railroad Crossing.

1. Reflecting material shall be for letters and numerals only, as called for on drawings.

2. Prior to application of reflex-reflecting sheet, the signs shall have complete treatment in accordance with section 11 as required.

13. *Reflex-reflecting sheet finish.*—Continued.

3. The reflex-reflecting letters and numerals shall conform to drawing and shall be pre-cut from material in accordance with Specification 255, Manual Part 276.

4. Application of letters and numerals shall be made in accordance with drawing, by activating the adhesive backing with the prescribed solvent or by heat, and then applying with a hand roller, squeeze roller or vacuum applicator to form a durable bond to the enamel finish.

(c) All letters and numerals shall be true as to edge and form, and shall be edge-sealed in accordance with Manufacturer's recommendations.

14. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and Manufacturer, upon request, shall advise Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

15. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

16. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

17. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

17. *Marking.*—Continued.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

18. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 2 years after shipment to Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than Manufacturer thereof, so as to affect, in Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-9-a.

Cast-aluminum adapter clamp, similar to Drawing 1647, shall be used to attach sign to mast.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 155-51—Railroad-Highway Grade Crossing Signs,
Manual Part 44.

Explanatory Statement

Specification 69-48—Signal Glasses, Manual Part 136, has been revised to eliminate the TAAR scale values and to show the transmittances for light source with color temperature 2854°K and correct the chromaticity diagram to more accurately describe the glassware color which may be furnished under this specification. The chromaticity diagram has been revised to conform to the standard limit glasses, the revision representing a scarcely noticeable color difference, but makes the specification, its diagrams and color definitions a technically consistent document, entailing no change in present requirements for railroad signal glasses. The revised specification, as herein presented, is now consistent with modern practice and terms.

As a matter of information, through the courtesy of the National Bureau of Standards, Photometry and Colorimetry Section, beginning on page 134 will be found a tabulation showing the values of transmittance for light of color temperature 2854°K corresponding to TAAR values etched on certified duplicates of primary standard glasses.

Also as information, on page 136 will be found a Bibliography containing references to various reports on the subject of color glasses.

(Revision of AAR Signal Section Specification 69-48)
AAR SIGNAL SECTION SPECIFICATION 69-59.

SIGNAL GLASSES

(Exclusive of Kerosene Lantern Globes)

1. *Purpose.*

(a) This specification is for the purpose of providing for glass roundels, lenses, discs, cones and slides for railroad signaling. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement of existing material when general renewal or replacement becomes desirable.

(b) Definition of the colors of signals constituting recommended railroad signal practice are set forth in the Appendix. This Appendix also describes the standard glasses to be employed in performing inspection.

2. *Specifications and Appendix.*

(a) Specifications and Appendix, referred to in the body of this specification, form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Type, size, and other required information as outlined in section 7.

4. Purchaser's order requirements.—Continued.

2. Manufacturer's reference number, designation of signal for which glassware is required or other identification.
3. Color designation and application as outlined in section 8.
4. Inspection and tests as required.
5. Alternate requisites as required.

5. Alternates.

- (a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. Material and workmanship.

- (a) Material and workmanship shall be first-class in every respect.
- (b) Glass shall be durable to prolonged exposure to normal atmospheric conditions and free from such streaks, wrinkles, chips or bubbles that detract from efficiency or use. Colored glass shall be colored throughout the body of the glass; cased glass shall not be used.

7. Design.

- (a) Signal glassware shall be of the following types:

1. Roundels.

- (a) Roundels shall be convex, conical, flat or other shape, as specified by Purchaser.
- (b) Roundels over $1\frac{1}{2}$ in. diameter having prismatic surfaces shall carry molded marking to indicate degree of beam deviation produced.

2. Discs.

- (a) Discs for searchlight signals shall have surfaces machine ground and polished or ground only (depolished), as specified by Purchaser.

3. Cones.

- (a) Cones 2 in. or less in diameter shall have molded surfaces, which may be smooth or diffusing, as specified by Purchaser.

4. Slides.

- (a) Slides shall be molded or cut to dimensions specified by Purchaser.

5. Lenses.

- (a) Lenses shall be specified by Purchaser as to diameter and focal length, and type, in accordance with the following designations:

1. Optical (spherical fresnel): Inner surface divided into concentric prismatic zones, outer surface convex smooth.
2. Spreadlight: Inner surface divided into concentric prismatic zones, outer surface fluted having

7. *Design.*—Continued.

molded arrows and numerals showing direction and degree of beam spread.

3. Cylindrical fresnal: Full 360 deg., or cylindrical section, with horizontal exterior prismatic zones.

4. Plano-convex: One surface plane (flat), one surface convex. Colored plano-convex lenses shall be limited to sizes not over 2 inches in diameter.

5. Other types, as specified by Purchaser.

8. *Color.*

(a) The color shall be one of the following, as specified by Purchaser:

1. Red.
2. Yellow.
3. Green.
4. Blue.
5. Lunar White.

(b) The color shall be suitable for the type and application as specified by Purchaser from Table I.

(c) The color shall be suitable for use with electric illuminant (incandescent lamp). *R-8-c.

(d) The glassware shall meet the chromaticity and transmittance requirements stated in Table I and section 11, for the type and application designated by Purchaser. Chromaticity and transmittance determine the color; see Appendix for definitions.

9. *Identification.*

(a) The individual pieces of glassware, large enough to carry molded lettering near the rim shall have molded identification giving Manufacturer's name or trade-mark, size, type and applicable aids to correct use such as focal length and beam spread. Colored glassware shall in addition have individual labels affixed at the time of production testing to certify that the pieces conform to this specification. Labels shall carry the name of the color in the cases of Blue, Lunar White, Highway Crossing (Hwy Xing) Red, and Lantern Red. Small items including 1-in. discs, cones and cut-to-size slides may omit molded marking, and color certification labels shall be attached to bundles of 10 pieces.

10. *Inspection.*

(a) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(b) The product furnished under this specification may be accepted upon Manufacturer's certification that it is in accord-

* Alternate requisites section.

TABLE I
Characteristics Requiring Test
According to Glassware Type and Application

Glassware type and application*	Color	Characteristic Chromaticity	Characteristic to be tested Transmittance (Indicated)	Serial No. of NBS limit glass represented by inspection standard**
Lenses, roundels, slides or wayside signals and train markers }	Red	Yellow Limit	0.047 min.	154 86
	Yellow	Red Limit		142
	"	Green Limit	0.30 min.	141 142
	Green	Pale Limit		134
	"	Blue Limit	0.20 min.	87 87
	Blue	Pale Limit	0.021 min.	47B
	"		Max. Red	57 47B & 86
	Lunar White	Yellow Limit		124
	"	Blue Limit	0.29 min.	73 73
	"			
Discs and cones for searchlight signals }	Red	Yellow Limit	0.064 min.	154 86
	Yellow	Green Limit		199
	"	Red Limit	Min. not specified	200
	Green	Pale Limit		139
	"	Blue Limit	0.183 min.	140 140
	Blue and Lunar White	Limits are same as for lenses, roundels, etc., above		
Roundels and lenses for highway crossings }	Red	Yellow Limit	0.127 min.	75 400
	"			
Electric hand lantern	Red	Yellow Limit	0.079 min.	126 211
	Yellow, Green, Blue, Lunar White	Limits are same as for lenses, roundels, etc., above		
	"			
<i>Alternate for use with kerosene illuminant:</i>				
Lenses, roundels, slides (for all applications) }	Lunar White	Yellow Limit		45
	"	Blue Limit	0.162 min.	74 74
	Red, Yellow, Green, Blue	Use same limits for kerosene as listed above for lenses, roundels, etc., with electric illuminant.		

* All applications shall be considered as using electric illuminant at approximately 2854°K except where alternate kerosene is specified. Kerosene hand lantern globes are covered by special color limits as listed in Specification 59, Manual Part 66.

** Supplier to use inspection standards certified as duplicates of National Bureau of Standards limit glasses.

10. *Inspection.*—Continued.

ance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and Manufacturer, upon request, shall advise Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(c) Labels affixed to the individual pieces of glassware at the time of production testing, section 9-a, may be accepted by the inspector as Manufacturer's certification that the pieces are in accordance with the specification.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

11. *Tests.*

(a) General.

1. Tests may be made at point of production, or on samples submitted, and may also be made at destination.

2. Manufacturer shall give Purchaser sufficient notice of time when the material or product will be ready for testing.

3. Manufacturer shall provide, at point of production, apparatus and labor for making required test under supervision of Purchaser.

4. If tests are to be made at point of production, it shall be so stated on Purchaser's order. Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material or product shall be tested.

5. Equipment for testing shall consist of certified standard filters representing chromaticity limits and known transmittances, a lamp or lamps standardized for a color temperature of 2854°K, and a photometer or color comparator or other instruments suitable for comparing the light transmitted by the glassware with that transmitted by the certified inspection standard. The inspection standards shall be in the form of flat polished glasses certified by the National Bureau of Standards as conforming to the tolerances for duplicates of the primary standards maintained at that Bureau. Detailed description of standards is given in the Appendix to this specification.

(b) Chromaticity requirement.

1. The acceptability of glassware for chromaticity shall be judged by a trained operator with normal vision using a color comparator to compare light transmitted by the glassware with light transmitted by the applicable inspection standard when each is transmitting light from an incandescent lamp having a color temperature of approximately 2854°K; or it may be measured with photoelectric equipment having sensitivity to chromaticity differences equivalent to the normal human eye. All glassware shall have chromaticity characteristics similar to those of the applicable standard. The procedure for chromaticity testing shall

11. *Tests.*—Continued.

be equivalent to that outlined in the Appendix. Acceptable glassware shall meet the following requirements:

(a) Red glassware shall be not visibly yellower nor less saturated in color than the yellow limit inspection standard.

(b) Yellow glassware shall be not visibly greener nor less saturated in color than the applicable green limit, nor redder than the applicable red limit inspection standard.

(c) Green glassware shall be not visibly yellower nor paler than the applicable yellow limit, nor bluer than the applicable blue limit inspection standard.

(d) Lunar White glassware shall be not visibly yellower than the applicable yellow limit nor bluer than the applicable blue limit inspection standard.

(e) Blue glassware shall be not paler than the applicable pale limit inspection standard and shall not pass any more red light than the pale limit inspection standard. The test for red light transmittance shall be accomplished by placing a duplicate of NBS Red glass No. 86 in front of one photometer lamp, then quickly alternating the blue glassware and the pale limit blue inspection standard in the line of vision with that lamp. Acceptable blue glassware shall appear equal to or darker than this inspection standard. Acceptance of a lot of blue glassware from the same production run for red light transmittance may be based upon a selected sample representative of the palest glassware submitted in the lot.

(c) Transmittance requirement.

1. Transmittance test shall be made on all glassware except yellow discs and cones. Measurement shall be made with a photometer and acceptability shall be dependent upon meeting the minimum values specified in Table I. The inspector shall require that each photometer operator demonstrate that the photometer is correctly calibrated. The procedure for transmittance test shall be equivalent to that outlined in the Appendix.

12. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

13. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages and on tags attached to loose pieces.

(b) Detail list of loose pieces, packages and their contents shall be furnished for each shipment.

14. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 90 days after shipment to Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-8-c.

Color shall be suitable for use with kerosene illuminant.

APPENDIX

(Specification 69)

Purpose.

In this Appendix are given the values and basis for numerical specification of signal colors, necessary test equipment characteristics, and tolerances for preparing certified duplicates of primary standard glasses.

The primary standards are the same as those in Specification 69, Manual Part 136, dated 1935 through 1948. Therefore, the tolerances on the product governed by them remains the same.

Basis of standards and measurements.

The values given in the specification were derived from spectrophotometric data obtained by the Photometry and Colorimetry Section, National Bureau of Standards; with defining glasses selected by Committee VI—Designs, of the Signal Section, AAR. These values were computed on the following basis:

1. Observer and co-ordinate system—1931 CIE* Standard.
2. Illuminant—CIE illuminant A (a gas-filled tungsten filament lamp operated at a color temperature of 2854°K according to the international temperature scale of 1948).
3. Angular incidence of illumination—approximately at right angles to the surface of the glass.

Chromaticity method of defining colors.

Any color can, in general, be adequately specified in terms of three colorimetric quantities. In the case of the signal colors, the three quantities adequate for the purpose are two numbers defining the chromaticity of the color and one number defining the luminous transmittance of the glass. Since no two observers would, in general, get the same numbers by direct observation (because of difference in luminosity function and chroma vision) it is desirable to express such numbers in terms of a hypothetical average normal observer. Such an observer was defined by resolutions adopted at the 1931 meeting of the International Commission on Illumination at Cambridge (Proceedings, pp. 19-29). The chromaticity of a color expressed in terms of this 1931 Standard Observer is given by numbers x , y and z (called chromaticity co-ordinates), which may be considered as the respective proportions of the red, green, and blue primaries in the color. Since the sum of x , y and z always equals unity, the chromaticity is adequately specified by giving two of the numbers x and y .

The chromaticity of all colors may, therefore, be represented graphically on a chromaticity diagram with values of y plotted against values of x . Permissible values of chromaticity for the signal colors are represented by certain areas on this diagram; the boundaries of these areas may be expressed as functions of x and y . It may be emphasized that x and y refer to the chromaticity of the *illuminant-glass combination* and that a glass which meets the requirements with a given illuminant may not do so with a different illuminant.

The graphic presentation of chromaticity areas for each color as governed by the primary standards has been redrawn so that the boundaries realistically

* CIE—Commission Internationale d'Eclairage (formerly ICI—International Commission on Illumination).

Chromaticity method of defining colors.—Continued.

define the glassware color quality obtainable with good inspection practice using certified duplicates of the primary standards. The boundaries thus take into account the accuracy of reasonable color-matching judgment by an inspector and the accuracy of preparing duplicates of the primary standards by the National Bureau of Standards.

Transmittance scale.

The transmission characteristics of signal glasses are expressed herein directly in terms of transmittances according to the CIE Standard Observer whereas earlier specifications used an arbitrary scale of "TAAR" values. That scale is being dropped because the TAAR values[†] were related to photometry using vacuum lamps or acetylene sources of color temperature 2360°K. The electric lamps now used in photometry and signal service are operated at substantially higher temperatures. Therefore, the color temperature of 2854°K is used throughout this specification. In the case of glassware destined for use with kerosene lamps and moderately reduced voltage electric lamps, the limit glasses and specification values have been so established that testing can be conducted at a color temperature of approximately 2854°K. (Kerosene burners are considered to provide a color temperature of 1900°K and incandescent lamps operated at 3,000 hours life approximately 2650°K.)

Testing equipment and methods.

An acceptable chromaticity testing instrument shall embody a divided viewing field where light passing through a test piece and light passing through a standard glass are viewed immediately adjacent to one another at a comfortable intensity with a dark surround. Means must be provided for adjusting these adjacent parts of the field to equal intensity while comparing their chromaticities. The light for the respective portions of the field shall originate from the same lamp, or from two lamps with independently adjustable current supplies to assure that light of the same color temperature illuminates the test piece and standard. With test piece and standard removed from the instrument, the portions of the field shall appear the same chromaticity without visible separation.

A Martens or similar polarizing prism type photometer shall constitute a satisfactory instrument for testing small glassware such as discs, cones and filters of uniform cross-section. For large glassware, each light source of photometer lamp shall be at least 2 inches in diameter and of uniform brightness. The source shall be located at the focal point for a lens or directly behind a representative central section for a prismatic roundel being tested. Glassware of uneven section such as blown lantern globes shall be tested through several places and judged as acceptable or rejectable by the extremes.

In order that photoelectric chromaticity testing equipment be considered qualifying under section 11-b of this specification for use instead of a visual instrument, it shall demonstrate a clearly readable response for the following co-ordinate differences in the respective color regions: red, $x = 0.0009$, $y =$

[†] For conversion of TAAR values to luminous transmittances, see National Bureau of Standards Research Paper 2849, NBS Journal of Research, Vol. 60, April 1958.

Testing equipment and methods.—Continued.

0.0003; yellow, $x = 0.0008$, $y = 0.0011$; green, $x = 0.0006$, $y = 0.0012$; blue, $x = 0.0003$, $y = 0.0004$; lunar white, $x = 0.0007$, $y = 0.0008$. Photoelectric transmittance measuring equipment, if used, shall employ a photo cell corrected to eye sensitivity and shall be accurate to plus or minus 2 per cent of each value indicated.

The transmittance measuring procedure, whether visual or photoelectric, for prismatic or diffusing lenses or roundels shall include calibrating the instrument by first substituting a colorless piece of glassware of the type to be tested and covering the test side of the eyepiece or photo cell with an appropriate transmittance standard. This transmittance standard is removed from the first field and replaced by plain, colorless glass during test of the colored lens or prismatic roundel. Calibration for the test of parallel surfaced, non-diffusing, colored glassware may be done with only the transmittance standard in place.

Blue glassware requires an additional test for the purpose of limiting its red light transmittance so as to prevent the signal appearing purple. (Small amounts of red light which might not be detected in a close range chromaticity test can give a distant blue signal a confusing purple appearance due to chromatic aberration of the eye. Many observers describe the purple indication as a pink spot surrounded by blue and since the colors appear to be separated in space, the CIE color mixture principles do not adequately describe visible differences.) There are two methods of measuring red transmission of blue glassware. The test method as required under section 11 of this specification is a simple comparison of the amount of red passed by the test piece with the amount passed by the pale limit blue standard. The other method, applicable to standard glasses, is calculation of T_r/T_w called the red to white ratio. This is defined as the ratio of light transmitted at wavelengths 650 mμ and longer to the total light transmitted.

APPENDIX TABLE I

Chromaticity definitions of signal colors.

Red for wayside signals and train markers:

- y is not greater than 0.288
- y is not less than $0.998-x$

Red for hand lanterns:

- y is not greater than 0.296
- y is not less than $0.998-x$

Red for highway crossings:

- y is not greater than 0.308
- y is not less than $0.998-x$

Yellow:

- y is not greater than 0.430
- y is not less than 0.384
- y is not less than $0.862-0.783x$
- x is not less than 0.554

APPENDIX TABLE I—Continued

Green:

- y is not less than $0.506-0.519x$
 y is not less than $0.150 + 1.068x$
 y is not greater than $0.817-x$

Blue:

- x is not greater than 0.179
 y is not greater than 0.209
 y is not greater than $0.734x + 0.088$
 Tr/Tw is not greater than 0.006

Lunar White:

- x is not greater than 0.441
 x is not less than 0.329
 y is not greater than $0.510x + 0.186$
 y is not less than $0.510x + 0.170$

APPENDIX TABLE II

Accuracy required in preparing duplicates of primary standard limit glasses for use as inspection limit glasses. Chromaticity co-ordinates and transmittances with 2854°K source. Serial numbers of glasses at National Bureau of Standards.

Application	Primary Limit Glass Chromaticity	Inspection Limit Glass Tolerances
Lenses, roundels, slides for wayside signals and train markers	Red, Pale Limit #154 x = .7132 y = .2867	$.2860 \leq y \leq .2875^*$ $y \geq .9995-x$ $.0900 \leq T \leq .1150$
	Red, Trans. Std. #86 x = .7224 y = .2776	$.2750 \leq y \leq .2785$ $y \geq .9995-x$ $.0490 \leq T \leq .0620$
Yellow, Pale & Green Limit #141	x = .5560 y = .4291	$.4275 \leq y \leq .4291$ $.8640 - .783x \leq y \leq .8660 - .783x$ $.4700 \leq T \leq .5200$
	Yellow, Red Limit & Trans. Std. #142 x = .5794 y = .4151	$.4135 \leq y \leq .4165$ $.8210 - .7027x \leq y \leq .8235 - .7027x$ $.3550 \leq T \leq .4000$
Green, Pale Limit #134	x = .2448 y = .4145	$.4125 \leq y \leq .4150$ $1.068x + .1530 \leq y \leq 1.068x + .1560$ $.2530 \leq T \leq .2830$
	Green, Blue Limit #87 x = .2084 y = .4016	$-.5190 + .5075 \leq y \leq -.5190x + .5120$ $.5000x + .2945 \leq y \leq .5000x + .2990$ $.1800 \leq T \leq .2200$
Blue, Pale Limit #47B	x = .1530 y = .1221	$.1201 \leq y \leq .1221$ $.1500 \leq x \leq .1530$ $.0335 \leq T \leq .0375$ $.004 \leq \text{Tr/Tw} \leq .006$
	Blue, Trans. Std. #57 x = .1440 y = .0862	$.0800 \leq y \leq .0920$ $.1420 \leq x \leq .1450$ $.0200 \leq T \leq .0230$ $\text{Tr/Tw} \leq .001$

* The expression $.2860 \leq y \leq .2875$ means y is equal to or greater than .2860 and y is equal to or less than .2875.

Oct. 1959]

APPENDIX TABLE II—Continued

Application	Primary Limit Glass Chromaticity	Inspection Limit Glass Tolerances
Lenses, roundels, slides for wayside signals and train markers—Contd.	Lunar White, Yellow Limit #124 x = .3654 y = .3688	$.3644 \leq x \leq .3664$ $.7000x + .1115 \leq y \leq .7000x + .1145$ $.3750 \leq T \leq .4175$
	Lunar White, Blue Limit #73 x = .3308 y = .3426	$.3298 \leq x \leq .3318$ $.8500x + .0605 \leq y \leq .8500x + .0640$ $.2750 \leq T \leq .3000$
Dises and cones for wayside signals	Red, Pale Limit #154	See above
	Red, Trans. Std. #86	See above
	Yellow, Green Limit #199 x = .5762 y = .4226	$.5752 \leq x \leq .5772$ $y \geq .9976-x$ Trans. Not Specified
	Yellow, Red Limit #200 x = .5889 y = .4073	$.5879 \leq x \leq .5899$ $y \geq .9962-x$ Trans. Not Specified
	Green, Pale Limit #139 x = .2634 y = .4376	$.4355 \leq y \leq .4380$ $1.068x + .1540 \leq y \leq 1.058x + .1590$ $.2350 \leq T \leq .2700$
	Green, Blue Limit #140 x = .2295 y = .4348	$.4325 \leq y \leq .4365$ $.2275 \leq x \leq .2315$ $.1750 \leq T \leq .2000$
Roundels and lenses for highway crossings	Red, Pale Limit #75 x = .6927 y = .3072	$.3060 \leq y \leq .3077$ $y \geq .9995-x$ $.1800 \leq T \leq .2100$
	Red, Trans. Std. #400 x = .7088 y = .2912	$.2900 \leq y \leq .2930$ $y \geq .9995-x$ $.1150 \leq T \leq .1400$
	Lenses for electric hand lantern	
Lenses for electric hand lantern	Red, Pale Limit #126 x = .7050 y = .2949	$.2936 \leq y \leq .2952$ $y \geq .9995-x$ $.1300 \leq T \leq .1550$
	Red, Trans. Std. #211 x = .7165 y = .2835	$.2810 \leq y \leq .2850$ $y \geq .9995-x$ $.0750 \leq T \leq .1000$
<i>Alternate for kerosene source:</i>		
Lenses, roundels, slides	Lunar White, Yellow Limit #45 x = .3122 y = .3279	$.3097 \leq x \leq .3122$ $x + .0145 \leq y \leq x + .0190$ $.2250 \leq T \leq .2575$
	Lunar White Blue Limit #74 x = .2711 y = .2852	$.2686 \leq x \leq .2711$ $1.1667x - .0312 \leq y \leq 1.1667x - .0260$ $.1600 \leq T \leq .1800$

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 69-48—Signal Glasses (Exclusive of Kerosene
Hand Lantern Globes), Manual Part 136.

VALUES OF TRANSMITTANCE FOR LIGHT OF COLOR
TEMPERATURE 2854°K CORRESPONDING TO TAAR
VALUES ETCHED ON CERTIFIED DUPLICATES
OF PRIMARY STANDARD GLASSES

The following certified duplicates of primary standards have been issued by the National Bureau of Standards and are in custody of various corporations and agencies. Those duplicate glasses have been identified by engraved serial numbers, color descriptions and transmissions according to the TAAR scale.

Actual transmittances on the basis of color temperature 2854°K are hereby published for information of such glass holders and become the values to be used in photometry of glassware in establishing compliance with minimum transmittances required under Table I of AAR Signal Section Specification 69, Manual Part 136.

Duplicate Glass No.	TAAR	T2854	Standard Glass No.	Duplicate Glass No.	TAAR	T2854	Standard Glass No.
157	179.	0.102	154	230	139.5	0.184	140
186	103.	.057	86	75 B	130.2	.0356	47 B
216	213.9	.508	141	B 110	74.8	.0216	57 B
213	160.	.374	142	P 83	130.9		56 P
194			199	P 94	72.6		47 P
225			200	P 73	38.9		80 P
207	205.4	.269	134	P 120	30.3		P 108
88	150.1	.201	87	64	121.4	.242	45
197	191.7	.249	139	154	83.	.168	74
227	139.3	.184	140	87	205.8	.403	124
46 B	130.	.0355	47 B	170	148.4	.293	73
B 112	74.7	.0216	57 B	204	257.	.150	201
P 82	130.2		56 P	218	146.	.082	211
45 P	72.8		47 P	263	303.	.721	261
P 76	39.2		80 P	273	255.	.591	271
P 123	30.1		P 108	244	187.8	.248	137
125	123.5	.246	45	254	127.5	.172	322
158	83.3	.168	74	B 150	125.4	.0338	B 141
93	206.	.403	124	B 137	55.8	.0162	B 131
165	148.6	.293	73	507	339.	.202	75
200	253.	.147	201	132	220.	.127	400
215	146.	.082	211	150	180.	.103	154
260	301.	.718	261	83	96.	.053	86
272	246.	.570	271	220	212.4	.504	141
242	187.6	.247	137	215	160.8	.376	142
255	128.2	.173	322	Y 38			199
B 149	124.7	.0337	B 141	229			200
B 136	55.7	.0162	B 131	261	207.1	.271	134
256	177.	.101	154	86	150.6	.202	87
191	105.	.058	86	201	191.3	.249	139
298			199	191	139.7	.185	140
305			200	45 B	130.2	.0356	47 B
301	191.5	.249	139	73 B	74.8	.0216	57 B
228	139.9	.185	140	53 P	131.4		56 P
74	39.4		80 P	58 P	72.8		47 P
P 125	30.1		P 108	P 78	38.8		80 P
255	169.	.097	154	P 119	30.3		P 108
141	103.	.057	86	65	121.7	.242	45
167	212.8	.505	141	159	82.7	.167	74
212	161.1	.377	142	90	206.1	.403	124
263	205.8	.269	134	164	148.6	.293	73
216	152.3	.204	87	308			200
B 113	128.7	.0352	47 B	205	255.	.149	201
B 59	74.3	.0214	57 B	219	147.	.083	211
P 149	130.7		56 P	265	303.	.723	261
P 98	72.1		47 P	274	252.	.584	271
75	120.8	.241	45	245	188.1	.248	137
161	83.	.168	74	253	126.7	.171	322
155	179.	.102	154	B 153	124.4	.0336	B 141
190	101.	.056	86	B 138	55.3	.0161	B 131
217	213.7	.507	141	254	177.	.101	154
210	160.6	.376	142	187	101.	.056	86
198			199	168	212.6	.504	141
231			200	208	161.2	.377	142
205	205.	.268	134	297			199
215	152.	.203	87	301			200
196	191.	.249	139	264	204.9	.268	134

Signal Section, AAR
Committee VI—Designs

135

Oct. 1959]

Duplicate Glass No.	TAAR	T2854	Standard Glass No.	Duplicate Glass No.	TAAR	T2854	Standard Glass No.
208	151.7	0.203	87	214	152.4	0.204	87
302	191.8	.250	139	199	190.2	.248	139
192	140.	.185	140	229	139.8	.185	140
94	206.2	.403	124	49 B	130.5	.0355	47 B
168	148.1	.292	73	B 109	74.5	.0215	57 B
184	173.	.098	154	57 P	132.1		56 P
188	100.	.056	86	P 91	73.3		47 P
223	213.6	.507	141	P 75	39.3		80 P
214	159.6	.373	142	P 122	30.2		P 108
195			199	42	121.9	.243	45
230			200	156	83.2	.168	74
203	204.7	.268	134	88	206.5	.404	124
211	152.5	.204	87	171	147.9	.292	73
200	190.2	.248	139	175	179.	.102	154
194	139.8	.185	140	192	100.	.056	86
48 B	130.4	.0356	47 B	219	214.4	.509	141
B 107	74.6	.0215	57 B	211	160.6	.376	142
64 P	131.9		56 P	197			199
P 97	72.6		47 P	227			200
P 71	39.4		80 P	206	205.2	.269	134
P 124	30.2		P 108	217	152.1	.204	87
66	121.4	.242	45	195	191.9	.250	139
157	83.	.168	74	193	139.5	.184	140
91	206.5	.404	124	B 118	129.9	.0355	47 B
166	148.4	.293	73	B 108	74.9	.0216	57 B
383	329.	.196	75	P 84	130.7		56 P
350	216.	.124	400	P 96	72.6		47 P
178	171.	.097	154	P 72	38.8		80 P
189	100.	.055	86	P 121	30.3		P 108
224	213.1	.506	141	63	121.8	.242	45
209	159.8	.374	142	155	83.1	.168	74
193			199	95	205.7	.402	124
226			200	167	147.9	.292	73
204	204.7	.268	134	209	254.	.148	201

Action Recommended

Acceptance as information.

BIBLIOGRAPHY

Color Science and Specifications

AAR Signal Section Proceedings:

- Vol. I, pp. 179-183, 294-306, 337-370, 371-384.
- Vol. III, pp. 272-291—The Optics of the Signal Lens, by Dr. Wm. Churchill.
- Vol. V, pp. 349-351—1908 Specifications for Signal Roundels, Lenses and Glass Slides.
- Vol. XI, pp. 596-606—Types of Signal Lenses, by Dr. H. P. Gage.
- Vol. XIV, pp. 37-40, 423-427—Specification for Hand Lantern Globes.
- Vol. XV, pp. 259-264—Specification for Signal Roundels, Lenses and Glass Slides.
- Vol. XXIV, pp. 82-86—Specification 5927—Hand Lantern Globes.
- Vol. XXIX, pp. 304-307—1932 Progress Report on Selection of New Color Limits.
- Vol. XXX, pp. 373-443—Bureau of Standards Report on Measurements of Limit Glasses.
- Vol. XXXII, pp. 251-261—Specification 69-35—Signal Glasses.
- Vol. XXXV, pp. 122-132—Specification 69-38—Signal Glasses.
- Vol. XXXV, pp. 133-143—Specification 59-39—Kerosene Lantern Globes.
- Vol. XXXVI, pp. 136-162—Bureau of Standards Report—Examination of Duplicate Limit Glasses.
- Vol. XXXVII, pp. 327-331—Specification 69-40—Signal Glasses.
- Vol. XLV, pp. 218-229—Specification 69-48—Signal Glasses.

National Bureau of Standards Research Paper RP1209, Standardization of the Luminous Transmission Scale Used in Specification of Railroad Signal Glasses by Gibson and Haupt—NBS Journal of Research, Vol. 36, Jan. 1936.

National Bureau of Standards Research Paper 1688, Specification of Railroad Signal Glasses by Gibson, Haupt and Keagan—NBS Journal of Research, Vol. 22, June 1939.

Proceedings of the International Commission on Illumination (CIE), Eighth Session, *Compte Rendu des Seances*, 1931, pp. 19-29.

The 1931 ICI Standard Observer and Co-ordinate System for Colorimetry, by D. B. Judd—*Journal of the Optical Society of America*, Vol. 23, p. 359 (1933).

Handbook of Colorimetry, by A. C. Hardy—The Technology Press, Massachusetts Institute of Technology, Cambridge, Mass., 1936. Standard Observer is defined on p. 7 et seq.

Rectangular Uniform-Chromaticity-Scale Co-ordinates, by F. C. Breckenridge and W. R. Schaub—*Journal of the Optical Society of America*, Vol. 29, p. 370 (1939).

Colorimetry—NBS Circular 478 (1950).

Oct. 1959]

A Co-ordinated Specification for the Colours of Light Signals, by J. G. Holmes—Proceedings of the International Commission on Illumination (CIE), Eleventh Session (Paris), 1948, p. 512.

Proceedings of the International Commission on Illumination (CIE), Twelfth Session (Stockholm), 1951, Vol. 1, Sec. 26e, and Vol. 3, pp. 70-73.

Spectrophotometry (200 to 1,000 millimicrons)—NBS Circular 484 (1949).

The Science of Color, Committee on Colorimetry of the Optical Society of America (see esp. Definitions, p. 363), 1953.

Proceedings of the International Commission on Illumination (CIE), Thirteenth Session (Zurich), 1955, Vol. 1, sec. 1.3.3.

National Bureau of Standards Research Paper RP2849, An Evaluation of the Luminous Transmittance Requirements for Railroad Signal Glassware in Terms of Standard Source A of the International Commission on Illumination, by F. C. Breckenridge—NBS Journal of Research, Vol. 60, April 1958.

Action Recommended

Acceptance as information.

COMMITTEE VII—MATERIALS RESEARCH

Personnel

T. T. Hart, Chairman

J. A. Balla, Vice-Chairman

O. G. Carey

C. W. Hoffman

M. M. Gager

L. E. Robinson

W. W. Hartzell

L. T. Thomas

H. B. Henry

H. L. Wallace

W. K. Waltz

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Investigate and report on Vinyl paint systems as compared to conventional paint systems now in use.
8. Investigate and report on the practical use of fiber glass as a structural material for signaling use.
9. Investigate and report on possible use of radioactive materials for lighting signal and switch lamps, collaborating with AREA Committees 5 and 9.
10. Investigate and report on the use of dry-charged storage batteries for use in signal service.
11. Investigate and report on the use of plastics in lenses, roundels and cover glasses for railroad use.
12. Specification for non-renewable air depolarized carbon caustic alkaline primary cells.
13. Investigate and report on the possible use of flexible tips for highway crossing gate arms.
14. Investigate and report on the use of fiber glass or plastics for use in cable risers or junction boxes.
15. Investigate and report on the use of plastic sprays for protective coating of signal equipment.

The committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 172-40, Manual Part 16.
3. Vinyl paint systems as compared to conventional paint systems now in use.
9. Investigation into the possible use of radioactive materials for lighting signal and switch lamps.
Nuclear light sources.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

10. Dry-charged storage batteries for use in signal service.
11. Plastic lenses, roundels and cover glasses for railroad use.
13. Flexible tips for highway crossing gate arms.
14. Fiber glass or plastics for use in cable risers or junction boxes.

Information

Specifications, etc., of other organizations referred to in the report of this committee may be procured from the following:

AREA—American Railway Engineering Association, 59 E. Van Buren St., Chicago 5, Ill.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee VII at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Specification 188-58—Cold Application Sealing Compound—Now in Manual Part 72.

Specification 184-58—Fusible Asphaltic Base Sealing Compound—Now in Manual Part 73.

PLASTIC LENSES, ROUNDELS AND COVER GLASSES FOR RAILROAD USE

Five railroads are conducting tests on plastic lenses for highway crossing protection. One railroad has had these lenses on trial since August 1956 where trouble was being experienced by vandals continually breaking the glass lenses. Some of the original lenses are still in service. Since August 1957, 60 additional plastic lenses have been installed where glass lenses were broken and only six of these lenses have been broken since their installation, indicating breakage had been reduced about 90 per cent. This railroad also reports that they have been unable to determine visually any change in color due to weather or sun effects on these lenses. Similar reports have been received from two other railroads who have had these lenses in service for a limited time. Tests of these lenses are also being conducted in desert territory to determine the effect of wind-driven abrasive particles and extreme sunlight. These lenses are commercially available at the present time.

At the request of some of the railroads, a manufacturer developed lenses and roundels for switch lamps, which are also on trial on a few railroads. With the greater number of switch lamps in service, and consequently increased chance for vandalism, this product offers the greater potential for savings to the railroads. This manufacturer is negotiating with switch lamp companies to develop a single-size lens, which can be used in any switch lamp by the use of adapters.

Action Recommended

Acceptance as information.

(Revision of AAR Signal Section Specification 172-40)
AAR SIGNAL SECTION SPECIFICATION 172-59.

AIR DEPOLARIZED PRIMARY CELL
(RENEWABLE TYPE)

1. *Purpose.*

(a) This specification is for the purpose of providing for a renewable type air depolarized carbon alkaline primary cell. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications and drawings.*

(a) Specifications and drawings referred to in the body of this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Ampere-hour capacity.
2. Type of jar and cover.
3. Inspection and tests as required.

(b) Each renewal in its entirety shall be ordered from one Manufacturer.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design.*

(a) Elements and covers shall be for use with jars, Drawings 1053 and 1419.

(b) Each complete cell, unless otherwise specified, shall consist of the following properly proportioned parts:

1. Positive and negative electrodes rigidly assembled, insulated and equipped with connecting wire and necessary suspension bolt.
2. Caustic alkali.
3. Battery oil.
4. Two washers.

6. *Design.*—Continued.

5. Two wing nuts.
6. One hexagonal nut.
7. One cover.
8. One glass jar.

(c) Each renewal shall include the following properly proportioned parts:

1. Positive and negative electrodes rigidly assembled, insulated and equipped with connecting wire and suspension bolt.
2. Caustic alkali.
3. Battery oil.

(d) Elements.

1. Cathode.

(a) It shall consist of porous carbon designed, constructed and treated so as to dispose of the gases generated during discharge of the cell at all temperatures and discharge rates the cell is designed to meet. It shall be active for not less than 2 per cent in excess of the rated ampere-hour capacity.

(b) Assembled connections shall be of low electrical resistance and free from harmful corrosive action.

2. Anode.

(a) It shall be basically of zinc of satisfactory quality properly amalgamated and of sufficient weight and texture to remain active for not less than 2 per cent in excess of the rated ampere-hour capacity.

(b) It shall be so formed and amalgamated that at no time shall there be a tendency to flake or shed portions that may produce an internal short circuit at discharge rates the cell is designed to meet.

(c) It shall be so designed that there is a visible indication of approaching exhaustion, and a further visible indication when the rated ampere-hour capacity of the cell has been delivered.

(d) Assembled connections shall be of low electrical resistance and free from harmful corrosive action.

3. Electrolyte.

(a) Electrolyte shall be a solution of caustic alkali. The caustic alkali shall be of proper quality and in a form which will dissolve readily in water. Irrespective of particle size or shape, not more than 10 per cent by weight of the caustic alkali as furnished shall pass a 100 mesh screen.

(b) The amount of caustic alkali shall provide for not less than 2 per cent in excess of rated ampere-hour capacity.

(c) Caustic alkali shall be delivered in a container, sealed and marked with the Manufacturer's name, type and capacity of cell for which intended.

6. *Design.*—Continued.

4. Oil.

(a) The correct amount of oil for each cell shall be supplied in a container securely sealed.

(b) Oil supplied to cover electrolyte shall be resistant to the action of caustic alkali and shall flow freely at 25 deg. F. It shall have proper surface tension to prevent creeping.

5. Jars.

(a) Jars shall be in accordance with Specification 113, Manual Part 9.

6. Wing nuts and washers.

(a) Wing nuts shall conform to Drawing 1053.

(b) Clamp nuts shall conform to detail 10707, Drawing 1070.

(c) Washers shall conform to detail 10708, Drawing 1070.

7. Covers.

(a) Covers shall be porcelain or other suitable material.

8. Connections.

(a) Wing nuts shall be used for fastening external connections to suspension bolt, positive post of battery.

(b) The suspension bolt of suitable material with 14-24 thread shall extend not less than $1\frac{1}{8}$ in. and not more than $1\frac{1}{2}$ in. above the top of cover when element is tightened to cover.

(c) A negative connection of soft-drawn insulated copper wire not less than No. 12 A.W.G. and of sufficient length to extend not less than 11 in. above the cover shall be provided.

7. *Inspection.*

(a) The product furnished under this specification may be accepted upon Manufacturer's certification that it is in accordance with the specification. If on arrival at destination the product is found not to meet the requirements of the specification it may be rejected and Manufacturer, upon request, shall advise Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

8. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of Purchaser.

8. *Tests.*—Continued.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. Purchaser shall indicate which of the tests herein specified are to be made and what portion of the product shall be tested.

(e) Cells shall be selected at random by picking out not more than 10 nor less than 3 from each 1,000 cells for each test.

(f) Cells shall be set up and handled strictly in accordance with Manufacturer's standard instructions.

(g) Tests shall be made at varying solution temperatures in a range between 25 and 90 deg. F.

(h) In all tests cells shall be so arranged that fresh air circulates freely over and around them.

(i) Voltage readings shall be taken directly across the terminals of the cells.

(j) Resistance shall be adjusted as necessary to maintain the desired discharge rate within plus or minus 1 per cent.

(k) Electrolyte temperature shall be measured at a point approximately 3 in. below the surface of the electrolyte and approximately 1 in. from the inside wall of the jar.

(l) Cells shall be tested in jars having a total capacity (plus or minus 2 per cent) as follows:

Ampere-hour capacity	Cubic centimeters
500 and 750	5,150
1,000	9,100

(m) In all tests water without injurious impurities shall be used.

(n) Elements shall have normal appearance during the entire test and the electrolyte shall remain sufficiently clear to allow inspection of the elements, and solution shall not show crystallization.

9. *Capacity test.*

(a) Cells shall be tested for capacity and low temperature performance by being placed on a continuous discharge at rates and duration shown in Table I for rated capacity. Voltages shall be as shown in Table I. During period of temperature changes, discharge shall be adjusted to 0.1 ampere.

(b) The period of time between temperature changes shall be not less than 8 hours nor more than 24 hours.

9. Capacity test.—Continued.

TABLE I
Complete Cycle Test

Discharge rates	Capacities		
	500 A.H. 1.1 Amps.	750 A.H. 2.25 Amps.	1,000 A.H. 1.5 Amps.
Hours of discharge.	1	1	1
Initial step with temperature range 80 ± 10 deg. F. Voltage shall not be below 1 volt during period of test.	7	35	7
	24	65	24
	72	135	72
	120	235	168
	168	*300	240
	240		336
	288		408
	336		504
	*409		576
			*600
Discharge rates			
	1 Amp.	1.5 Amps.	1.25 Amps.
Hours of discharge.	1	1	1
Intermediate step with temperature range 27 ± 2 deg. F. Voltage shall not be below 0.9 volt during period of test.	5	3	7
	7	9	24
	10	15	
	20	20	
	24		
	30		
Discharge rates			
	1.1 Amps.	2 Amps.	1.5 Amps.
Hours of discharge.	1	1	1
Final step with temperature range 80 ± 10 deg. F. Voltage shall not be below 1 volt during period of test.	7	5	25
	**18	10	**46
		**23	

Notes:

Test to be continued to determine that 2 per cent excess capacity is obtained.

Ampere-hours discharge during temperature changes shall be computed and be included in ampere-hours.

*Check should be made to note that indication of approaching exhaustion is apparent at this point.

**Check should be made to note that indication of rated capacity has been reached at this point.

10. Packing.

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages.

(b) Detail list of packages and their contents shall be furnished for each shipment.

12. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to Purchaser. This warranty shall not apply to any product which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 172-40—Air Depolarized Carbon Caustic Soda Primary Cell,
Manual Part 16.

DRY-CHARGED STORAGE BATTERIES FOR USE
IN SIGNAL SERVICE

The basic reason for the interest in dry-charged cells is due to the number of charged wet cells that have been charged in transit, also the ease of storeroom stocking the dry-charged cells without requiring periodic boost charges.

At first glance, the dry-charged cell would appear to be the answer to the signal cell problem; however, there are factors to be considered, as follows:

1. The average dry-charged signal cell would deliver approximately 50 per cent of its rated capacity when first filled with electrolyte, due to the loose pack construction and thickness of the plates. After filling, the cell should be allowed to stand from 1 to 10 hours depending upon the manufacturer and then given a freshening charge. The dry-charged cell will require a minimum of 24 hours charge at a rate in accordance with manufacturer's instructions. This time period may have to be extended depending on length of time the cell has been in storage.

2. There would be quite a problem of handling electrolyte to fill the dry-charged cells, and there would be the problem of additional space required to store the electrolyte.

3. In a charged wet cell, the electrolyte acts as a cushion on the element, and there would be far more chance of damage to the element of a dry-charged cell in transit than there would be to a charged wet cell. In addition, the wet cell is charged and tested at the factory before shipment, while the true condition of a dry-charged cell is not known until after it is filled with electrolyte, charged and tested by the customer.

4. Added cost for:

- (a) Charging equipment.
- (b) Handling, such as time required to fill cells, connect and disconnect for freshening charge.
- (c) Inspection of cells for concealed damage.
- (d) Handling electrolyte in and out of Stores Department.
- (e) Delay time in giving battery freshening charge.

When all factors are considered, it would appear that the dry-charged storage cell would not be satisfactory for general use in signal service.

To correct the problem of damage to charged wet cells in transit, it is possible a better packing case could be developed.

Action Recommended

Acceptance as information.

INVESTIGATION INTO THE POSSIBLE USE OF RADIOACTIVE MATERIALS FOR LIGHTING SIGNAL AND SWITCH LAMPS*

This report is a result of investigation held by Subcommittee C of Committee VII at the U. S. Radium Corp. Plant and Laboratories, Bloomsburg, Pa. on October 22, 1958.

The U. S. Radium Corp. has manufactured several prototype switch lamps powered by a radioisotope which are in service for testing purposes on approximately five railroads in this country. One of these railroads has ordered 50 additional lamps for use in a classification yard.

These switch lamps are designed to replace kerosene burning switch lamps. They do not have brightness equivalent to electrically lighted switch lamps, nor can a radioactive light source be used at this time in block signals.

These switch lamps use Krypton-85 (Kr-85), a radioactive gas, to excite phosphor crystals to emit visible color light. Kr-85 was chosen as the radioisotope for several reasons. Since it is a gas which diffuses very rapidly, it will not contaminate the surrounding atmosphere if the source were accidentally broken. Therefore, no clean-up problem exists. In addition, Kr-85 is an inert gas which cannot undergo chemical reaction within the body to cause retention of the isotope if it were accidentally breathed in. Kr-85 has a long half-life of about 10 years. This means that one-half of the isotope in the switch lamp will be "used up" in the first 10 years. Light output decreases at approximately this same rate. Since the Kr-85 gas generates no heat and in most sources is under a negative pressure, accidental fracturing of source would result in an implosion rather than an explosion.

Kr-85 is a by-product of nuclear reaction. It is obtained from the Atomic Energy Commission installation at Oak Ridge, Tenn. The supply is unlimited for all practical purposes. Kr-85 costs about \$15 per curie at present, and there is a good possibility the cost will go down. The decay scheme of Kr-85 results in beta particles and approximately $\frac{1}{2}$ per cent of relatively low energy gamma rays. The beta particles excite the phosphor crystals. The beta particles are shielded completely by the lantern housing, but the gamma rays present more of a shielding problem.

One prototype switch lamp was constructed as follows: Four glass bulbs were coated with phosphor, filled with Kr-85 gas, hermetically sealed, and were then mounted on a block. This assembly was inserted into a switch lamp. Around each bulb was a parabolic reflector. In front of each bulb was a glass plate in which was imbedded wire similar in appearance to chicken wire. Next was a plastic filter which, coupled with the type of phosphor coating the bulb, produced the color desired. On the outside was a glass lens.

The glass bulbs in each switch lamp contain a total of 600 to 1,000 millicuries of Kr-85. Each bulb is filled individually and sealed. The diameter of the present bulb is approximately $\frac{3}{4}$ inch. One serious problem encountered initially and overcome was the discoloration of the glass bulb due to damage caused by the beta radiation. A special glass is now used in which the discoloration results in the absorption of less than 10 per cent of the emitted light.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 158-A and 339-A.

The function of the glass plate containing imbedded chicken wire is as follows:

1. To minimize bulb breakage from external causes.
2. To minimize tendency to contact bulb with fingers in event of breakage of outer glass lens.
3. To aid in shielding against the gamma radiation present.

Earlier prototype switch lamps did not have colored plastic filters. The filters are now used to gain a sharper color, and to avoid color washout when hit by direct headlight beam. The basic color is determined by the phosphor used. Zinc sulfide and zinc cadmium sulfide are used as phosphors. Some of these are copper activated. Radiation damage to the phosphors is negligible. Some of the colors produced in switch lamps are red, yellow, green, blue and lunar white. Red is the most difficult color to obtain.

The type of lens on the switch lamp varies between railroads. Some roads require a spreadlight lens. Spread angle specifications vary—15 degrees, 20 degrees, 30 degrees, etc., being required. Other roads prefer a bull's-eye lens. This variation in lens requirements presents problems to the manufacturer since, to obtain a particular color, the filter and phosphor must be matched and the lens adapted to the system. The effective range of visibility of the lamp also varies with the type of lens. If fewer lens types could be agreed upon, the railroads would benefit. The outside diameter of the lenses we saw used were $6\frac{3}{8}$ inches.

The switch lamp housings have been made of either cast aluminum or welded $\frac{1}{4}$ inch or $\frac{1}{8}$ inch steel. The latter type housing is more adapted to quantity production since different background targets can be painted the appropriate colors and screwed to the housing in the final assembly stage. It should be noted that the colored background and the correspondingly colored plastic filter and reflecting system provide an indication of switch position when a locomotive headlight strikes lantern in event light source is lost through a bulb leak. The lamp housing is about as large as clearance permits in order to increase the distance between the Kr-85 and outside of the housing to keep the radiation level external to the lamp at a low level. A large housing is also required since the bulbs are mounted from within. Provisions are made to lock the housing permanently to the switch stand. All screw holes are filled to make disassembly difficult. The housing is sturdily constructed for railroad service and to shield gamma rays. The weight of the housing is about 42 pounds.

In regard to shielding, the Atomic Energy Commission (AEC) required that the radiation level, 12 inches from the surface of the housing, not exceed 5 millirem per hour. If this level is exceeded, signs must be posted in the area warning of radiation. Since the posting of signs would be undesirable, the radiation level 12 inches from the lamp housing is below 5 millirem per hour. Each lamp installation is licensed by the AEC, and any user is thus assured that the lamps and the installation are hazard-free when used in the manner for which they are licensed. No leakage test is required to be performed on a lantern in the field since Kr-85 is a gas which diffuses rapidly. Two warning plates are mounted on the top and bottom of the lamp housing. The lamps present no storage problem in quantity. The only field maintenance normally required is to wipe the lens clean.

The life expectancy of the switch lamp is difficult to estimate as it depends upon the minimum acceptable range of visibility for a particular installation. The range of visibility of these lamps is determined by a number of factors. The major factors are the brightness of the light source, the color of the emitted light, the filtering required to obtain the desired color, the size and type of lens, the observer's dark adaptation, and the ambient light level in the viewing area. Because of the reduction in light intensity with time, the source intensity with Kr-85 will be reduced approximately one-half in 10 years. Railroads could aid in the development of these new light sources by establishing minimum visibility ranges for switch lamps in yards and for main track use. The available light levels are not sufficient for main track use, but establishing the minimum visibility range would be helpful in working toward this goal.

Nighttime observations were made of two different types of switch lamps as well as a brighter type single-unit lamp. The sky was overcast, no stars or moon, and there was very little ambient light. It was raining slightly.

Two switch lamps were equipped with 30-degree spreadlight lenses and displayed green, red, yellow and lunar white. These lamps each had four separate Kr-85 bulbs, parabolic reflectors and appropriate filters. One other switch lamp was an experimental model less than a week old which had only one bulb, no reflectors, a bull's-eye lens and four filters to give two yellow and two green lights.

Two single-unit one-directional lamps in yellow and green had parabolic reflectors and flat lenses. These lamps were about twice as bright as the switch lamps and also exceeded the 5 millirem per hour level mentioned previously, although this can be modified through the use of thicker glass lenses. They could be seen over 1,000 feet away, the green being the more distinctive.

The 30-degree spreadlight lens lamps were visible from about 200 feet. The green color was very good. The lunar white, yellow, and red colors will require some additional work to make them more favorably distinctive. The lunar white was the poorest color.

The bull's-eye lens lamp could be easily seen from a greater distance than the 30-degree spreadlight lens lamps. This distance varied with the observer, but all agreed that green was easier to distinguish at a greater distance than the yellow. The bull's-eye lens is highly directional, of course. If an observer were to get roughly 10 degrees either side of the direct line of sight, the color displayed by this lamp would be lost completely. This critical distance either side of the line of sight decreases as the observer approaches the lamp since the angle of deviation is constant. The proper focusing of this lamp is more critical than a spreadlight lens unit for this reason.

Automobile headlights were directed onto these lamps to get some idea of the effect of a locomotive headlight. The green color held up very well while the other colors became less distinctive. The painted backgrounds did, of course, show clearly. The lunar white looked green to several observers, a very undesirable condition.

One possible area of improvement in lamps lies in the development of a single-bulb unit. The single bulb would simplify lamp construction, make the unit more economical to manufacture, and increase the brightness over the four-bulb type. Another area of improvement is in the use of glass filters over the plastic ones. The use of glass filters could eliminate one layer of material between the bulb and lens since the glass filter could also serve as mechanical

protection for the bulb. Since the plastic filter absorbs about 8 per cent of the light output, an increase in brightness would result in its elimination. A glass filter is not economical at this time since colors are not final and sales volume is not large.

Action Recommended

Acceptance as information.

NUCLEAR LIGHT SOURCES*

A research agreement was made with Armour Research Foundation whereby their nuclear physics staff has been engaged during 1958 in studying the possibilities of utilizing nuclear light sources for the permanent illumination of railroad roadway signs. Preliminary work involved a search of the literature followed by studies of the possibilities of using nuclear batteries buried in the ground to generate high voltage, low amperage current which could be used to illuminate specially designed bulbs in the sign. It was concluded, however, that this method of illumination offered little hope of being within economic limits. It was further concluded that the use of radioactivated phosphors offered the most promising field for success. Work during the latter part of the year, therefore, has been directed towards obtaining increased intensity of illumination using compacted or crystallized mixtures of radioactive materials and phosphors to obtain this objective. Regulations and requirements for the safe handling of radioactive materials add greatly to the difficulty of finding a satisfactory nuclear light source for this purpose.

Final report on Feasibility Studies on New Nuclear Light Sources appears in AREA Bulletin No. 549, Vol. 60, p. 693.

Action Recommended

Acceptance as information.

FLEXIBLE TIPS FOR HIGHWAY CROSSING GATE ARMS

In an effort to determine the possible use of flexible tips for gate arms, three manufacturers and two suppliers of highway crossing gate arms were contacted and asked for information.

The main advantage of a flexible tip on a highway crossing gate would be in its ability to deflect without breaking when struck by a motor vehicle. A hinged type tip could be constructed to provide movement of the tip horizontally and to spring to the normal position when the deflecting force is removed.

The two suppliers listed some problems and possible disadvantages connected with the use of flexible tips as follows:

1. For a hinged type, a high wind could blow the flexible tip against line wires when the gate is in the vertical position or against the side of a passing train when the gate is in the horizontal position.

* Excerpt from 1958 Annual Report of the AAR Research Center.

2. For the non-hinged type, there would be a problem of maintaining the alignment of the flexible tip with the rest of the gate arm under normal circumstances.

None of the three manufacturers of gate arms has made a flexible tip, but all three have given consideration to such a design at some time. Two of the manufacturers seem to believe that a hinged type tip offers the most promise as a possible design. One of the manufacturers is currently experimenting with different methods, materials and constructions, and has advised that they will contact us when they find something satisfactory.

It would appear obvious that a flexible tip on a highway gate arm would reduce breakage resulting from motor vehicles striking the gate tip as the vehicles were driven around the gate in its horizontal position. What is not obvious to the manufacturers of highway gate arms is how much of a demand, if any, exists among the railroads for gate arms with flexible tips. Until the need for flexible tips is clearly demonstrated, there seems to be little possibility that the manufacturers will go to the expense of designing and marketing a flexible tip for gate arms.

Action Recommended

Acceptance as information.

FIBER GLASS OR PLASTICS FOR USE IN CABLE RISERS OR JUNCTION BOXES

To procure information on the utilization of fiber glass or plastics for use in cable risers or junction boxes, five manufacturers and suppliers of cable risers and junction boxes were asked if they had ever considered using fiber glass or plastics for such products.

Four out of five replies indicated that the use of fiber glass or plastics had not been seriously considered for the following reasons:

1. High cost of molds.
2. Relatively high cost of material compared to cast iron, steel or aluminum.
3. Possible high fabricating costs.
4. Lack of sales volume for finished products.

One manufacturer contacted has had more experience with fiber glass, having successfully marketed a primary battery box out of this material. They investigated the possibility of molding a one-piece cable riser, using fiber glass, on which several types of bootleg heads could be used. Because of the insulating property of fiber glass, a separate piece of insulation between riser and head would be unnecessary. It was found that such a bootleg could be made, but, even disregarding a very substantial mold cost, such a riser could not be made to compete with the cost of a cast-iron riser plus the cost of insulation between the riser and bootleg head. The manufacturer could not see sufficient advantage in using the fiber glass riser to warrant the higher price which would have to be applied to it. Several types of pole line junction boxes were also

investigated. Again it was found that fiber glass at its present cost, cannot compete with cast iron or aluminum, even disregarding mold charges.

Action Recommended

Acceptance as information.

VINYL PAINT SYSTEMS AS COMPARED TO CONVENTIONAL PAINT SYSTEMS NOW IN USE*

Reports of trials conducted by railroads indicates that extreme cleaning and preparation of surfaces are necessary before Vinyl paint systems can be applied. Such preparation can be accomplished economically only in a shop or factory on a production basis.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 153-A and 338-A.

COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION

Personnel

P. H. Foley, Chairman

A. C. Jacobsen, Vice-Chairman

H. A. Appleby	E. J. Seybold
W. E. Blevins	C. L. Summers
J. W. Gavey	H. W. Trawick
E. W. Horning	C. N. Tymeson
R. W. Kile	E. B. Walkup
B. F. McGowan	R. B. Whalen
R. J. Nester	W. K. Wood
W. E. Peeler	H. A. Franklin*
O. S. Penman	D. M. Noell*
D. E. Peterson	H. M. Taylor, Jr.*
H. C. Sampson	R. B. Thomas*

G. M. Dempsey†

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Report on noteworthy developments in highway grade crossing protection.
4. Prepare typical location plans for highway grade crossing protection devices, collaborating with AREA Committee 9.
7. Investigate and report on methods for preventing unnecessary operation of automatic highway grade crossing protection devices.
14. Investigate and report on methods to improve effectiveness of railroad-highway grade crossing protection devices.
15. Prepare information regarding highway grade crossing protection signals and signs and their observance by highway users.
18. Investigate and report on factors involved in the use of NUMBER OF TRACKS signs in connection with highway grade crossing protective devices, collaborating with AREA Committee 9.
19. Investigate and report on vertical clearance requirements over highways in various states and make recommendations for revision, if necessary, of Drawings 1686F and 1688D, collaborating with AREA Committee 9.
20. Investigate and report on methods used for control of automatic highway crossing signals and devices on other than main tracks.
21. Investigate and report on location of automatic highway grade crossing signals and devices at multiple track crossings.

* Consulting Member.

† Consulting Member from Safety Section, AAR.

The committee submits for consideration, reports on the following subjects*:

1. Revision of AAR Sig. Sec. 1730A, 1731A, 1732A and 1733A.
15. Highway grade crossing protection signals and signs and their observance by highway users.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee VIII at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

- AAR Sig. Sec. 1734A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1735A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1736A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1737A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1738A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1739A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1740A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1741A—Typical Location Plan (Composite) for Automatic Flashing Light Signals With Gates—Acute Angle—Divided Highway—Now in Drawing Section of Manual.
- AAR Sig. Sec. 1742A—Typical Location Plan (Composite) for Automatic Flashing Light Signals With Gates—Obtuse Angle—Divided Highway—Now in Drawing Section of Manual.
- Requisites for Control of Automatic Highway Grade Crossing Signals and Devices—Now in Manual Part 274.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

AAR SIG. SEC. 1730B.

TYPICAL LOCATION PLAN FOR AUTOMATIC GATES
AND FLASHING LIGHT SIGNALS
RIGHT ANGLE CROSSING

AAR SIG. SEC. 1731B.

TYPICAL LOCATION PLAN FOR AUTOMATIC GATES
AND FLASHING LIGHT SIGNALS
ACUTE ANGLE CROSSING

AAR SIG. SEC. 1732B.

TYPICAL LOCATION PLAN FOR AUTOMATIC GATES
AND FLASHING LIGHT SIGNALS
OBTUSE ANGLE CROSSING

AAR SIG. SEC. 1733B.

TYPICAL LOCATION PLAN FOR AUTOMATIC GATES
AND FLASHING LIGHT SIGNALS
CURB AND GUTTER LOCATION

These drawings have been revised to conform with typical location plans now in the Manual.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

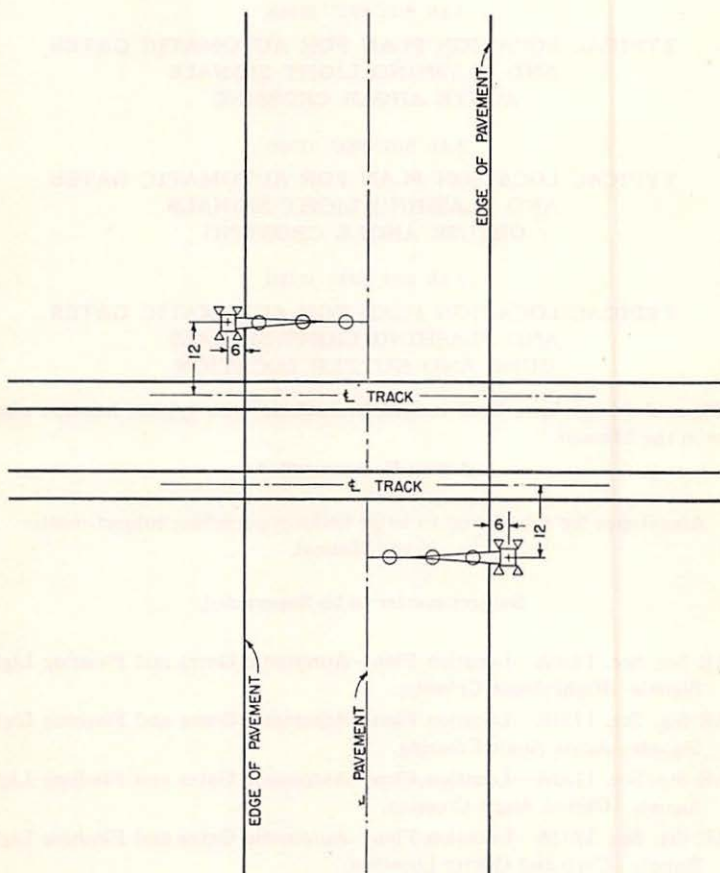
Subject-matter to be Superseded

AAR Sig. Sec. 1730A—Location Plan—Automatic Gates and Flashing Light Signals—Right Angle Crossing.

AAR Sig. Sec. 1731A—Location Plan—Automatic Gates and Flashing Light Signals—Acute Angle Crossing.

AAR Sig. Sec. 1732A—Location Plan—Automatic Gates and Flashing Light Signals—Obtuse Angle Crossing.

AAR Sig. Sec. 1733A—Location Plan—Automatic Gates and Flashing Light Signals—Curb and Gutter Location.



NOTE: PLAN MAY BE VARIED AS CONDITIONS REQUIRE.
ALL DIMENSIONS SHOWN IN FEET

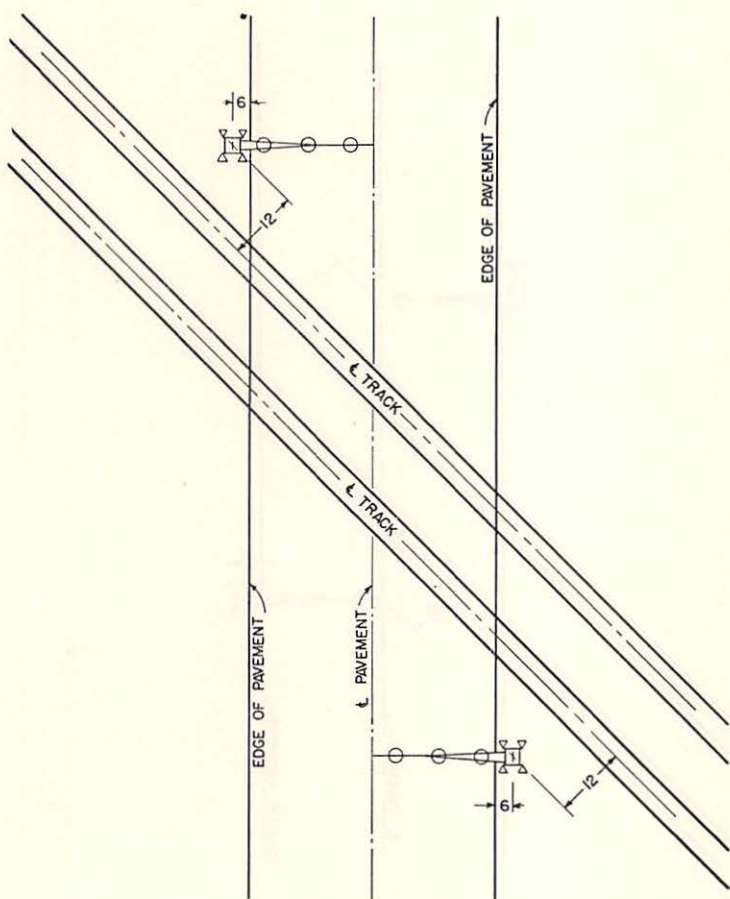
TYPICAL LOCATION PLAN FOR AUTOMATIC GATES AND FLASHING LIGHT SIGNALS

RIGHT ANGLE CROSSING

AAR
SIG. SEC.

OCT 1959 / M - 1953 SEP 1953

1730B



NOTE: PLAN MAY BE VARIED AS CONDITIONS REQUIRE.
ALL DIMENSIONS SHOWN IN FEET

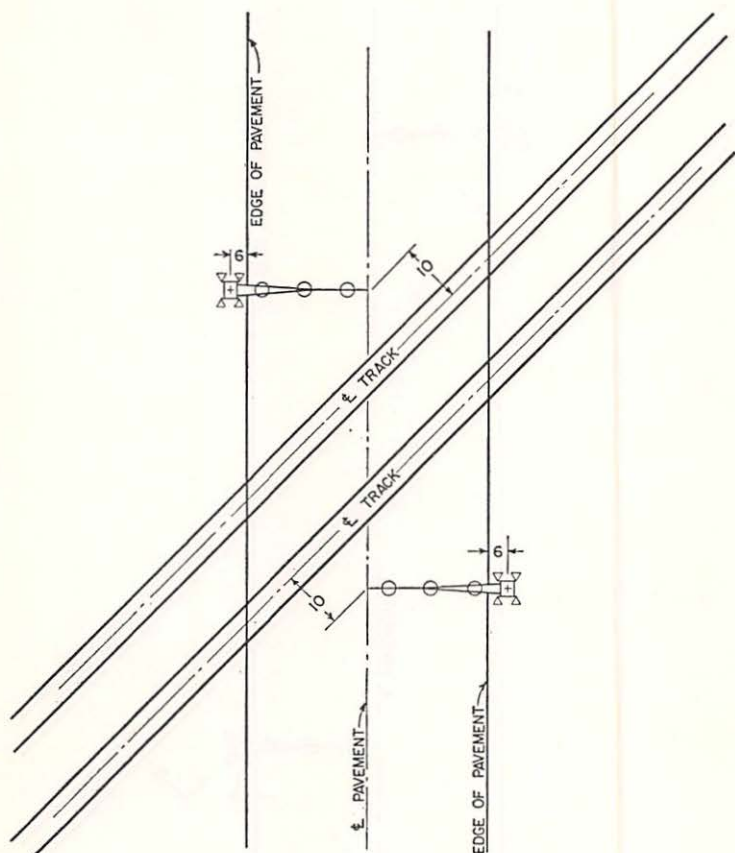
TYPICAL LOCATION PLAN FOR AUTOMATIC GATES AND FLASHING LIGHT SIGNALS

ACUTE ANGLE CROSSING

AAR
SIG. SEC.

OCT. 1959/M - 1953 SEP. 1953

1731B



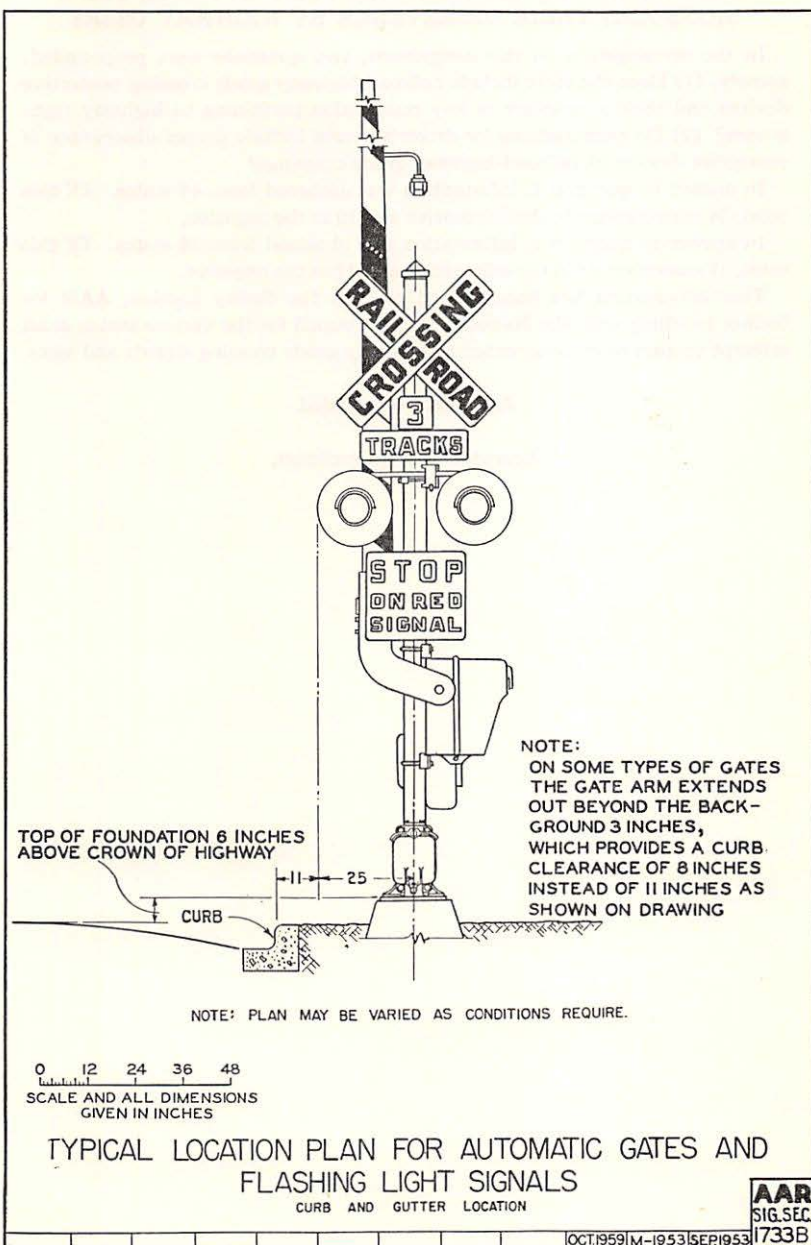
NOTE: PLAN MAY BE VARIED AS CONDITIONS REQUIRE.
ALL DIMENSIONS SHOWN IN FEET

TYPICAL LOCATION PLAN FOR AUTOMATIC GATES AND FLASHING LIGHT SIGNALS

OBTUSE ANGLE CROSSING

AAR
SIG. SEC.

OCT 1959/M - 1953 SEP 1953 1732B



HIGHWAY GRADE CROSSING PROTECTION SIGNALS AND SIGNS AND THEIR OBSERVANCE BY HIGHWAY USERS

In the investigation on this assignment, two questions were propounded: namely, (1) Does the state include railroad-highway grade crossing protective devices and their observance in any publication pertaining to highway regulations? (2) Do examinations for driver's license include proper observance of protective devices at railroad-highway grade crossings?

In answer to question 1, information was gathered from 44 states. Of this total, 34 answers were in the affirmative and 10 in the negative.

In answer to question 2, information was obtained from 38 states. Of this total, 21 answers were in the affirmative and 17 in the negative.

This information has been turned over to the Safety Section, AAR for further handling with the National Safety Council for the various states in an attempt to gain more observance to highway grade crossing signals and signs.

Action Recommended

Acceptance as information.

COMMITTEE IX—WIRE AND CABLE

Personnel

V. O. Smeltzer, Chairman

R. W. Margsh, Vice-Chairman

W. W. Beard

J. E. Schweigert

J. W. Curran

R. M. Spillman

M. J. Folley

M. R. Steele

W. B. Johnson

W. M. Vogts

M. A. Nyberg

R. H. Youngblood

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
5. Investigate and report on the use of aluminum wire for railway signaling.
10. Investigate and report on use of new types of plastic wire insulation.

The committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 90-52, Manual Part 26.
- Revision of Specification 168-55, Manual Part 173.
- Revision of Specification 223-47, Manual Part 238.

Information

Specifications, etc., of other organizations referred to in the report of this committee may be procured from the following:

American Standard—American Standards Association, 70 E. 45th St., New York 17, N. Y.

ASTM—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee IX at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Specification 89-58—Braid-Covered Cable—Now in Manual Part 25.

Specification 240-48—Neoprene Sheathed Cable—Now in Manual Part 249.

Instructions for Wiring—Now in Manual Part 84.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

(Revision of AAR Signal Section Specification 90-52)
AAR SIGNAL SECTION SPECIFICATION 90-59.

LEAD SHEATHED CABLE, SUBMARINE

1. *Purpose.*

(a) This specification is for the purpose of providing for multiple-conductor insulated submarine signal cable having lead sheath and round steel armor for use on circuits rated at 0-600 and 601-2,500 volts. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications and standards.*

(a) Specifications and standards† referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall be for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Size, number and arrangement of conductors.
2. Voltage rating.
3. Thickness of insulation.
4. The continuous length in which cable shall be furnished.
5. Inspection and tests as required.
6. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Conductor.*

(a) The conductor shall be of soft or annealed copper, properly coated with tin, lead or lead-alloy, and have properties, charac-

† American Standards referred to in this specification are issued by the American Standards Association.

7. *Conductor*.—Continued.

teristics and stranding in accordance with ASTM current Specifications B 33 or B 189, and B 8, Table II, except as otherwise required by this specification.

(b) Conductor shall be ASTM Class C concentric-lay stranded. Sizes Nos. 2 to 14 A.W.G., inclusive, shall have 19 strands and sizes Nos. 1 to 0000 A.W.G., inclusive, 37 strands.
*R-7-b.

8. *Insulation*.

(a) Conductors shall be individually insulated with a properly vulcanized synthetic rubber-like compound which shall be homogeneous in character, tough, elastic and applied concentrically about the conductor, and shall fit tightly thereto. Where insulation is applied in more than one layer, adjacent layers shall be vulcanized into a homogeneous mass. The insulation shall be tested in accordance with ASTM current Specification D 470, and shall be in accordance with the following performance requirements which are applicable to insulation having nominal wall thickness of $\frac{3}{64}$ in. or greater (*R-8-a):

1. Physical properties:

Original properties:	A†	B††
Tensile strength, min. psi.....	700	600
Elongation at rupture, min. per cent	300	250

Properties after accelerated aging:

Oxygen pressure test—168 hours—

176 F. (80 C.)—300 psi.

Tensile strength, min. per cent of original.....	50	50
Elongation, min. per cent of original	50	50

Air pressure heat test—20 hours—

260 F. (127 C.)—80 psi.

Tensile strength, min. per cent of original.....	50	50
Elongation, min. per cent of original	50	50

† Values in Column A are for insulations which have been vulcanized once.

†† Values in Column B are for insulations which have received the second vulcanization incurred by the vulcanization of the neoprene compound sheath.

2. Insulation resistance constant:

Megohms—1,000 ft. at 60 F. (15.6 C.) min.....	10,000
---	--------

3. Mechanical water absorption:

7 days—158 F. (70 C.)—mg./sq. in. max.....	20
--	----

* Alternate requisites section.

8. *Insulation.*—Continued.

4. Electrical stability in water on insulated conductors only:

1,000 cycles—122 F. (50 C.)

Dielectric constant.

1-day immersion—max. 4.5

Increase in dielectric constant.

1-14 days—per cent max. 6

7-14 days—per cent max. 2.5

Power factor.

14 days—per cent max. 1.5

(b) The thickness of the insulation shall be thickness A or D of Table I, for 0-600 volts or 601-2,500 volts unless otherwise specified by Purchaser.

(c) The insulating compound shall be clean and free stripping, leaving the coated conductor unimpaired and ready for soldering.

(d) No outer covering shall be provided on individually insulated conductors of cable. *R-8-d.

TABLE I

For Circuits Rated 0-600 Volts

Thickness	Size of conductor	Insulation thickness on each conductor, 64ths of an inch	Test voltage
A	No. 14 to No. 8 A.W.G.	5	6,000
	No. 7 to No. 2 A.W.G.	6	7,500
	No. 1 to No. 0000 A.W.G.	7	9,000
B	No. 14 to No. 8 A.W.G.	4	5,000
	No. 7 to No. 2 A.W.G.	5	6,000
	No. 1 to No. 0000 A.W.G.	6	7,500
C	No. 14 to No. 9 A.W.G.	3	3,500
	No. 8 to No. 2 A.W.G.	4	5,000
	No. 1 to No. 0000 A.W.G.	5	6,000

For Circuits Rated 601-2,500 Volts

D	No. 14 to No. 8 A.W.G.	10	12,500
	No. 7 to No. 2 A.W.G.	10	12,500
	No. 1 to No. 0000 A.W.G.	10	12,500
E	No. 14 to No. 8 A.W.G.	9	11,000
	No. 7 to No. 2 A.W.G.	9	11,000
	No. 1 to No. 0000 A.W.G.	9	11,000
F	No. 14 to No. 8 A.W.G.	7	9,000
	No. 7 to No. 2 A.W.G.	8	10,000
	No. 1 to No. 0000 A.W.G.	8	10,000

* Alternate requisites section.

9. *Assembly.*

(a) Multiple-conductor cables shall be made by assembling individual and twisted pairs of insulated conductors into a tight cylindrical form. Individual and twisted pairs of conductors shall be assembled helically with adjacent layers wound in opposite directions. One conductor in each layer shall be taped or otherwise suitably marked to serve as a tracer. The assembly shall be covered with compound-filled cable tape, and then with a lead sheath. Over the lead sheath shall be laid a layer of impregnated jute bedding, then the round steel armor. An outside layer of impregnated jute covering shall be laid over the round steel armor.

(b) Twisted pairs shall be formed from two individually insulated conductors, one suitably marked for identification, cabled with a length of lay as short as good construction will permit and not longer than 10 in. The length of lay of adjacent pairs shall differ by at least $\frac{1}{2}$ in.

(c) Twisted pairs shall be assembled as the center of the cable and individually insulated conductors arranged concentrically about the core thus formed.

(d) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices and if necessary to make cable assembly round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices.

10. *Cable tape.*

(a) Compound-filled tape and the method of its application shall be in accordance with ASTM current Specification D 1350, sections pertaining to cable tape.

11. *Lead sheath.*

(a) Lead sheath and thickness of lead sheath shall be in accordance with current American Standard C8.15.

(b) Lead sheath shall be commercially pure lead. *R-11-b.

12. *Armoring and covering.*

(a) The lead-covered cable shall be armored with galvanized round steel wire laid over a jute bedding and served overall with a layer of jute yarn in accordance with current American Standard C8.15, sections pertaining to "Jute Bedding for Armored Cable" and "Galvanized Steel Wire Armor."

(b) Thickness of the jute bedding over which galvanized round steel wire armor is laid shall not be less than $\frac{1}{64}$ in.

* Alternate requisites section.

13. *Identification.*

(a) Cable shall be identified by a tape under the lead sheath showing the name of Manufacturer and the year in which the cable was manufactured. This information shall appear at intervals of not more than 30 in.

14. *Inspection.*

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and Manufacturer, upon request, shall advise Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

15. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. Voltage and insulation resistance tests shall be performed in water on the full reel lengths of the individual conductors. These tests shall be repeated dry on the reel lengths of completed cable except that the voltage test shall be at 80 per cent of the voltages specified in Table I. Purchaser shall indicate which of the tests on samples herein specified are to be made and what portion of the material or product shall be tested.

16. *Samples for test.*

(a) One sample shall be taken from the first 10,000 ft. of completed cable or fraction thereof and one from each additional 10,000 ft. or fraction thereof for each of the acceptance tests specified by Purchaser.

(b) If Purchaser intends to test more than this number of samples, such intention shall be indicated at the time of asking for quotations.

17. *Acceptance requirements.*

(a) The finished cable and individual conductors in cable shall withstand successfully the tests required by this specification and applicable specifications or American Standards referred to in this specification.

18. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

(b) Cable shall be shipped on substantially constructed reels that are of suitable size and in good condition. The reels shall be properly lagged or otherwise protected.

(c) Reels shall be provided with cast-iron bushing or iron plate at the center on each side having hole of sufficient size to take shaft suitable for the weight of the cable.

(d) Both ends of the cable shall be available for testing, properly sealed, and protected against damage.

19. *Marking.*

(a) Purchaser's order, requisition and reel number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of reel.

(b) Detail list of reels shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

(c) Reels shall be plainly stenciled with arrow and suitable accompanying wording on each end of reel, indicating which way it shall be rolled, and a full description of the cable showing size and number of conductors, character of insulation, number of feet and gross weight of reel.

Alternate requisites.

R-7-b.

1. Conductor shall be ASTM Class B concentric-lay stranded. Sizes Nos. 2 to 14 A.W.G., inclusive, shall have 7 strands and sizes Nos. 1 to 0000 A.W.G., inclusive, 19 strands.

2. Conductor shall be solid for sizes No. 6 A.W.G. and smaller, and ASTM Class B concentric-lay stranded for sizes larger than No. 6 A.W.G.

3. Stranding of conductor shall be

R-8-a.

1. Conductors shall be individually insulated with a properly vulcanized rubber compound known as natural rubber AO insulation, and shall be in accordance with the composition, chemical, physical and electrical requirements for natural rubber AO insulation specified in ASTM current Specification D 27.

R-8-d.

1. Individual insulated conductors shall be covered with a neoprene compound sheath in accordance with Specification 239, Manual Part 248.

(a) Neoprene compound sheath over individual conductors shall be bonded to insulation.

Alternate requisites.—Continued.

(b) When neoprene compound sheath is provided over insulation of individual conductors, insulation thickness A or D, Table I, shall be reduced by $\frac{1}{64}$ in., but the test voltage shall be based on combined thickness of insulation and sheath.

(c) Voltage and insulation resistance tests on wire covered with outer neoprene compound sheath shall be made only on finished wire and the insulation resistance shall be not less than 60 per cent of that required for the primary insulation based on the combined thickness of insulation and sheath.

R-11-b.

Alloy lead sheath shall be commercially pure lead to which shall be added an alloying element of 2 per cent tin (minimum 1.8 and maximum 2.2).

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 90-52—Lead Sheathed Cable, Submarine, Manual Part 26.

(Revision of AAR Signal Section Specification 168-55)
AAR SIGNAL SECTION SPECIFICATION 168-59.

LINE WIRE

1. *Purpose.*

(a) This specification is for the purpose of providing for line wire with weather-resistant braid, neoprene or polyethylene covering for use on signal circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for replacement on existing installations when general renewal or replacement becomes desirable.

2. *Specifications and standards.*

(a) Specifications and standards[†] referred to in the body of this specification form an essential part hereof.

3. *Tender.*

(a) The tender shall for for a product meeting the requirements of this specification in its entirety.

4. *Purchaser's order requirements.*

(a) The following additional requirements will be shown on Purchaser's order:

1. Size of conductor, A.W.G. (or B.W.G. for copper-bearing steel).
2. Type of conductor.
3. Per cent conductivity if copper-covered steel type.
4. Type of covering, or bare.
5. Lengths of wire to be furnished in each coil or reel.
6. Inspection and tests as required.
7. Alternate requisites as required.

5. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

7. *Conductor.*

(a) Conductor shall be one of the following as specified on Purchaser's order:

1. Type I. Solid copper alloy line wire in accordance with ASTM current Specification B 105 for Alloy No. 30,

[†] American Standards referred to in this specification are issued by the American Standards Association.

7. Conductor.—Continued.

before weatherproofing. After weatherproofing, conductors shall meet the requirements of current American Standard C8.18 (for URC type), current American Standard C8.34 (for neoprene type), or current American Standard C8.35 (for polyethylene type). Conductors shall be of diameters that correspond to A.W.G. sizes Nos. 4, 6, 8, 9 and 10.

2. Type II. Copper-covered steel line wire, high strength grade, 30 or 40 per cent conductivity, as specified on Purchaser's order, in accordance with ASTM current Specification B 227, of size Nos. 4, 6, 8, 9, 10 or 12 A.W.G.

3. Type III. Solid galvanized, copper-bearing, Grade BB steel line wire with Class A zinc coating, in accordance with ASTM current Specification A 111, before weatherproofing, of size Nos. 4, 6, 8 or 9 B.W.G. After weatherproofing, conductor minimum breaking strength limits shall be 5 per cent less than required by the applicable referenced bare wire specification.

4. Type IV. Solid hard-drawn copper line wire in accordance with ASTM current Specification B 1, before weatherproofing. After weatherproofing, conductor shall meet the requirements of current American Standard C8.18 (for URC type), current American Standard C8.34 (for neoprene type) or current American Standard C8.35 (for polyethylene type). Conductor sizes shall be of diameters that correspond to A.W.G. sizes Nos. 4, 6, 8, 9 and 10.

8. Covering.

(a) Covering when required shall be one of the following as specified on Purchaser's order:

1. Double braid weather-resistant covering, saturant and finish in accordance with current American Standard C8.18.

2. Triple braid weather-resistant covering, saturant and finish in accordance with current American Standard C8.18.

3. Neoprene covering in accordance with current American Standard C8.34.

4. Polyethylene covering in accordance with current American Standard C8.35.

9. Identification.

(a) Covered wire shall be identified in accordance with method specified in applicable current American Standard C8.18, C8.34 or C8.35, so that Manufacturer can be ascertained.

10. Inspection.

(a) Purchaser may inspect the material or product at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

10. *Inspection.*—Continued.

(c) If product has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and Manufacturer, upon request, shall advise Purchaser what disposition is to be made of the rejected product. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

11. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give Purchaser sufficient notice of time when the material or product will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order.

12. *Samples for test.*

(a) Samples of covered wire for test shall be taken in accordance with current American Standard C8.18 (for URC type), current American Standard C8.34 (for neoprene type) or current American Standard C8.35 (for polyethylene type), sections pertaining to "Samples for Test."

(b) Samples of bare wire for test shall be taken in accordance with applicable ASTM current specifications.

13. *Acceptance requirements.*

(a) The finished wire shall withstand successfully the tests required by this specification and applicable specifications or American Standards referred to in this specification.

14. *Weights and tolerances.*

(a) Conductors.

1. The conductors, the nominal weights of which are shown in Table I, shall not vary beyond the limits given in section 7.

(b) Coverings.

1. The average weight of the completed covering of weather-resistant wire, including all fibrous covering, saturant and finish, shall be in accordance with current American Standard C8.18, section pertaining to "Weights and Tolerances;" neoprene covering shall be in accordance with current American Standard C8.34; polyethylene covering shall be in accordance with current American Standard C8.35.

TABLE I
Nominal Weights of Conductors, Coverings and Finished Wire
(Lbs. per 1,000 Ft.) Breaking Load (Lbs.) and Thickness of Covering

Size ¹ A.W.G.	Bare conductor	Covering				Finished Wire				Breaking load (lbs.)	Thickness of Covering 64ths of an inch	
		Double braid	Triple braid	Neo- prene	Polyeth- ylene	Double braid	Triple braid	Neo- prene	Polyeth- ylene		Neo- prene	Polyeth- ylene
Copper Alloy												
4	126.4	24.6	37.6	25.6	9.6	151.0	164.0	152.0	136.0	2772	3	2
6	79.5	20.5	32.5	21.5	7.5	100.0	112.0	101.0	87.0	1856	3	2
8	50.0	16.0	25.0	18.0	6.0	66.0	75.0	68.0	56.0	1206	3	2
9	39.5	14.9	22.4	16.4	5.4	54.5	62.0	56.0	45.0	967	3	2
10	31.4	14.6	21.6	9.2	5.1	46.0	53.0	40.6	36.5	775	2	2
Copper-Covered Steel												
										40% 30%		
4	115.8	24.6	37.6	25.6	9.6	140.4	153.4	141.0	125.0	3541 3934	3	2
6	72.8	20.5	32.5	21.5	7.5	93.4	105.4	94.3	80.3	2433 2680	3	2
8	45.8	16.0	25.0	18.0	6.0	61.8	70.8	63.8	51.8	1660 1815	3	2
9	36.3	14.9	22.4	16.4	5.4	51.2	58.7	52.7	41.7	1368 1491	3	2
10	28.8	14.6	21.6	9.2	5.1	43.4	50.4	38.0	33.9	1130 1231	2	2
12	18.1	10.2	15.2	7.7	4.2	28.3	33.3	25.8	22.3	785	2	2
Copper-Bearing Steel												
B.W.G.												
4	152.4	29.6	45.6	29.2	10.9	182.0	198.0	181.6	163.3	2156	3	2
6	110.9	24.6	37.6	25.6	9.6	135.5	148.5	136.5	120.5	1567	3	2
8	73.2	20.8	32.8	21.7	7.5	94.0	106.0	94.9	80.7	1035	3	2
9	58.9	18.6	29.1	20.0	6.8	77.5	88.0	78.9	65.7	836	3	2
Copper												
A.W.G.												
4	126.4	24.6	37.6	25.6	9.6	151.0	164.0	152.0	136.0	1872	3	2
6	79.5	20.5	32.5	21.5	7.5	100.0	112.0	101.0	87.0	1216	3	2
8	50.0	16.0	25.0	18.0	6.0	66.0	75.0	68.0	56.0	785	3	2
9	39.6	14.9	22.4	16.4	5.4	54.5	62.0	56.0	45.0	628	3	2
10	31.4	14.6	21.6	9.2	5.1	46.0	53.0	40.6	36.5	503	2	2

14. *Weights and tolerances.*—Continued.

(c) Finished wire.

1. The weight of finished wire in Table I is shown as information.

15. *Packing.*

(a) Product shall be so assembled or packed as to permit convenient handling and to protect against loss or damage during shipment.

(b) Wire shall be furnished in coils of lengths specified by Purchaser but not less than the following lengths (*R-15-b):

Size	Length, mile
4	$\frac{1}{4}$
6-8	$\frac{1}{3}$
9-10-12	$\frac{1}{2}$

(c) Diameter of the eye of the coil shall be not less than 18 in. nor more than 22 in.

(d) Each coil shall be securely bound with a wrapping of two-ply weatherproofed crepe paper, overlapping not less than one-half its width.

16. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of packages.

(b) Detail list of packages and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

17. *Warranty.*

(a) Manufacturer shall warrant the product covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within 1 year after shipment to Purchaser. This warranty shall not apply to any product which shall have been repaired or altered in any way by anyone other than Manufacturer thereof, so as to affect, in Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-15-b.

Wire shall be furnished on reels, amply strong, protected by lagging, bound with wire to prevent damage in transportation.

* Alternate requisites section.

Alternate requisites.—Continued.

Reels shall contain lengths as specified by Purchaser but not less than the following:

Size	Length, mile
4	$\frac{1}{4}$
6-8	$\frac{1}{3}$
9-10-12	$\frac{1}{2}$

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 168-55—Line Wire, Manual Part 173.

(Revision of AAR Signal Section Specification 223-47)
AAR SIGNAL SECTION INSTRUCTIONS.

SPICES IN INSULATED WIRES AND CABLES*

1959

These instructions apply to the splicing of insulated wires and cables used in electrical circuits and connections of signaling systems and apparatus. They set forth general requirements representing recommended practice.

General.

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

2. Each circuit, the functioning of which affects the safety of train operation, except circuit which includes any track rail must be kept free of any ground or combination of grounds as instructed. In no case shall a flow of current be permitted which is equal to or in excess of 75 per cent of the release value of any relay or other electromagnetic device in the circuit.

Splicing of insulated wire and cable.

3. Splicing of insulated wire and cable should be performed in accordance with instructions supplied by the manufacturer of the particular type of wire or cable to be spliced. Splicing kits commercially available may be used if desired.

4. Instructions of a general nature applying to splicing of wire and cable are as follows:

(a) The splice must be moisture-proof and must be insulated to have adequate dielectric strength and insulation resistance.

(b) Moisture must be excluded from a joint during the splicing operation and the work should be done in dry weather or under shelter. Perspiration from the splicer's hands should be wiped off with dry material. All materials and tools involved in the splicing process must be kept dry and clean.

(c) Sweating or soldering must be done with an iron of sufficient weight so that there will be heat enough to cause the solder to run into all the crevices, or by pouring, having the solder hot enough to run properly. After the joint is cold, the solder applied to the joint should show a shiny surface free from sharp points of solder.

* The term "as instructed" as used herein refers to individual railroad instructions.

Splicing of insulated wire and cable.—Continued.

(c) Exposed insulation and the pencil shaped surface must be thoroughly cleaned. The insulation and the conductor may be thinly coated with an approved cement which should be allowed to dry until it is only slightly sticky.

(d) Rubber insulating tape in accordance with Specification 56, Manual Part 158, or other insulating tape, must then be applied over the exposed insulation and conductor in layers approximately half-lapped and wrapped tightly and smoothly, building up the thickness across the splice to about one and one-half times the original thickness and tapering off toward the ends of the exposed insulation, as shown on Fig. 1.

(e) Insulating tape of a suitable width must be used for small size conductors, and up to 2 inches in width for large size conductors. Each layer must be treated as recommended by manufacturer in order to fuse the wrappings together.

(f) Over rubber tape or other insulating tapes as required, two layers of friction tape in accordance with Specification 82, Manual Part 157, must be applied overlapping one-half its width, and over this must be applied two coats of insulating paint, the first being allowed to dry before the second coat is applied.

6. Multi-conductor splices must be made in accordance with the following, or as instructed:

(a) General.

1. In all cases, joints in the various conductors must be made in the same manner as described under Instructions 4 and 5. Friction tape may be omitted on each spliced conductor except for larger sizes where tape should be applied.

2. The joints must be staggered and bunched together and two layers of friction tape must be applied to the whole joint bunch, over which should be applied two coats of insulating paint, the first being allowed to dry before the second coat is applied.

3. If the cable contains fillers of jute or other material, it must be removed from the joint bunch, cutting it back as far as possible.

(b) Lead sheathed cables.

1. Before opening the cable the splicer must see that he has all necessary instructions and material and must determine in advance just how the splice is to be made.

2. The cable to be joined must be placed in position and, with the ends together, the splice should be measured and the sheath marked where it is to be cut. The splice must be made 3 inches shorter than the sleeve to be used.

3. The sheath must be scraped bright with a shave hook for a distance of 4 inches beyond the marks, care being used to leave no dull streaks as they may result in bad joints. The scraped surface must be immediately coated with stearine.

4. A ring about the sheath must be cut with a chipping knife at the point marked, care being taken not to cut entirely through the sheath.

Splicing of insulated wire and cable.—Continued.

5. The end of the cable must be bent back and forth slightly until the lead breaks at the cut ring. In most cases the sheath can then be pulled off the cable but it must not be forced, and, if necessary, the part to be stripped should be scored lengthwise and opened up before removal.

6. The cable must be carefully examined at the points scored to make certain that the insulation has not been injured, and the butt of the sheath examined for burrs liable to injure the insulation.

7. Sleeves must be of lead $\frac{1}{8}$ inch thick. Inside diameter must be $\frac{1}{2}$ to 1 inch larger than outside diameter of cable sheath. The length of the sleeve will depend on the number and size of conductors. For most splices 18-inch sleeves are satisfactory. Sleeves must overlap lead sheath not less than $1\frac{1}{2}$ inches at each end.

8. The ends of lead sleeves must be cut off square, tapered and cleaned with a rasp for approximately 2 inches. The tapered surfaces must be immediately coated with stearine to keep them clean and act as a flux in soldering. The lead sleeve must be slipped over the end of the cable and pushed back out of the way of splicing. In handling the sleeve, care must be taken not to rub the stearine off the ends. The sleeve must be slipped over the completed splice, centered to cover the same amount of sheath at each end and carefully beaten in to make contact with the sheath.

9. Cable pasters must be placed to allow a space of 2 inches for wiping the joint. The one on the cable sheath must be not less than 1 inch from the sleeve. Joints must be well tinned and then wiped to shape with 40/60 solder in accordance with AAR Communications Section Specification 1-A-38, except the joints in submarine cables where 45/55 solder must be used.

10. Solder must be heated until it is thin and pours readily. Any dirt collecting on the surface must be skimmed off with a ladle. Solder which has been previously used for tinning or wiping other metals must not be reused. Lead sleeving or cable sheath must never be melted and used as wiping solder.

11. Joints must be carefully examined for blow holes, using a mirror to examine the underside.

(c) Armored cables.

1. In all cases, joints in single-conductor and multi-conductor armored cables must be made in the same manner as described under Instructions 4 and 5.

2. The protective covering, unless otherwise instructed, must be removed from the two ends of the cable to be spliced, leaving exposed 3 inches of lead sheath, where used, and 2 inches of armor on each side of the space required for the splice, for attaching bonding ribbon. The surfaces of the short exposed ends of cable sheath and armor to which the bonding ribbon is to be soldered must be thoroughly cleaned and tinned.

3. After protective coverings are removed and before any splicing is started, bonding ribbon must be applied to make sheath and armor electrically continuous across the splice.

Splicing of insulated wire and cable.—Continued.

4. Bond must consist of two tinned soft copper bonding ribbons 0.064 inch by $\frac{3}{8}$ inch wide, each a continuous piece. Length of bonding ribbon must be sufficient to permit placing straight sleeve back over end of cable without breaking or removing ends of bonding ribbon. Approximately 7 feet of bonding ribbon when double (14 feet when single) will be required per splice.

5. After first end of double bonding ribbon is soldered to cable sheath and armor, it must be laid along cable so that lead sleeve can be placed over it. Double bonding ribbon must then be bent back over lead sleeve and soldered to armor and cable sheath at opposite end.

6. Splices in armored cables buried in the ground must be protected from mechanical injury by enclosing them in an approved metal or creosoted wood box. Before placing splice in protective joint box, bonding ribbon must be folded carefully and held in place with friction tape, after which four coats of insulating paint and three layers of friction tape or muslin must be applied alternately, completely covering sleeve, bonding ribbon, sheath, armor and end of jute covering over armor, allowing each coat of paint to dry before applying the next layer of friction tape or muslin.

7. Splice in underground wire or cable must have insulation resistance to ground and to other wires at least equal to that of the wire being spliced.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 223-47—Splices in Rubber-Insulated Conductors and Cables, Manual Part 238.

COMMITTEE X—SIGNALING PRACTICE

Personnel

J. R. DePriest, Chairman

A. L. Essman, Vice-Chairman

W. R. Baker

A. J. Hendry

M. F. Black

A. L. Jordan

L. S. Bottinelli

J. I. Kirsch

E. A. Burgin

E. A. Krause

H. W. Dunn

C. Meyers

H. B. Garrett

R. C. Steele

D. H. Green

H. E. Webb

L. B. Yarbrough

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Report on noteworthy changes in signal methods and practices.
5. Investigate and report on new and improved signal devices and related appliances.
8. Investigate and report on the use of check in and check out systems.
9. Specification for proper rate of operation and on time energization for a flashing signal aspect other than used for highway crossing signals.
10. Investigate and report on ways and means of interconnecting hot box detectors with signal systems and how the equipment is used when not so interconnected.
11. Requisites for yard switching system.

The committee submits for consideration, reports on the following subjects*:

3. Noteworthy changes in signal methods and practices.
5. New and improved signal devices and related appliances.

Disposition of 1958 Letter Ballot Subjects

The following subjects presented by Committee X at the 1958 Annual Meeting were submitted to letter ballot and officially approved:

Requisites for Protection for Spring Switches—Now in Manual Part 10.
Signaling for Gravity Classification Yards—Now in Manual Part 42.

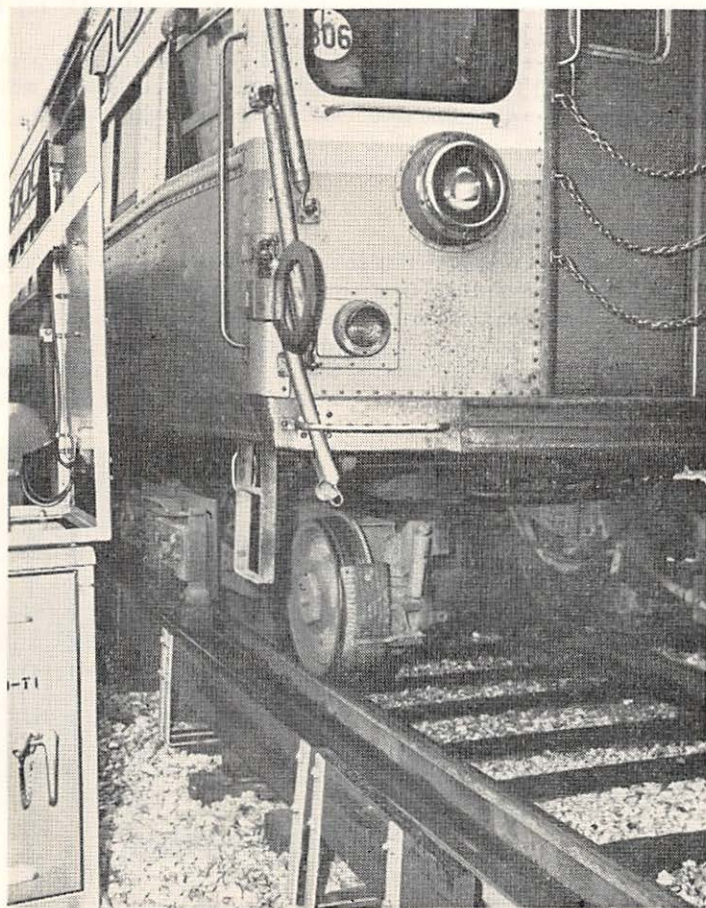
* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

NOTEWORTHY CHANGES IN SIGNAL METHODS
AND PRACTICES*

It should be understood that this is solely a report to inform the members of the availability of the various devices mentioned therein, and what the manufacturers claim they will do. It is submitted as information and does not constitute any Signal Section recommendation.

Train identity system.

A completely transistorized system has been developed by which a train can identify itself and cause an external control circuit to operate. It may be used for automatic routing, to light station platforms, turn on train announcing systems, etc.



* Previous report on this subject appears in AAR Signal Section 1954 Proceedings, Vol. LII, pp. 161 and 213.

Each train carries an inert coil and tuning unit in a quick-detachable assembly, mounted on the head end as illustrated. The coil may be tuned to any one of nine available identification channels.

The wayside equipment consists of an amplifier, and for each channel a filter and a Type B1 relay (up to nine channels may be used), all mounted on a relay rack in a small housing also shown in the illustration. An assembly consisting of two coils and an adjusting device is mounted on the roof of the housing.

The input of the amplifier is connected to one wayside coil, and the output connected to the other. When the train-carried coil is within range, it acts as an inductive coupling link between the two wayside coils. This causes the amplifier to oscillate at the frequency to which the train-carried coil is tuned.

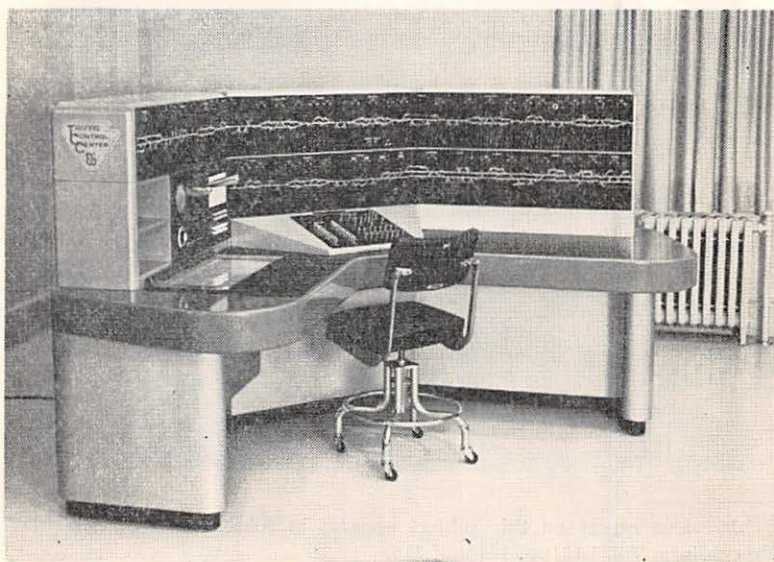
The amplifier output is also connected to the filter units. Since each filter is sensitive to one frequency channel, only one unit responds and only its associated relay picks up, to operate the external circuit.

The system operates on 115 volts a.c. and requires 1.6 watts of input power. No power is required for the inert train coil. Operating range is 24 inches between the moving and wayside coils. Maximum train speed is 80 miles per hour.

This is a development of the General Railway Signal Co.

Traffic control center.

A new traffic control center, here illustrated, has been developed to facilitate the control of greater territory from a central point and from one control machine. This control center presents a new concept in traffic control. It is considerably different from other styles of machines which have been used, and provides a means for concentrating the control of traffic into a center small enough so that one person can control a greatly increased mileage of territory.



Oct. 1959]

The controls have been concentrated in a control console located in the center of the desk in such a manner that the entire control center may be operated from one position. Instead of turning levers to actuate switches, signals and other functions, one merely operates the desired buttons. As with previous arrangements, the intended controls are stored in circuits until the start button is pushed or the stored condition is canceled. The ability to line up many miles of signaling in advance of a train has not been changed. An improved method for blocking functions or routes on the control center has been provided.

The general principles of operation of this control center can be applied to large or small interlockings, the consolidation of such interlockings, or centralized control of large territories of single or multiple track.

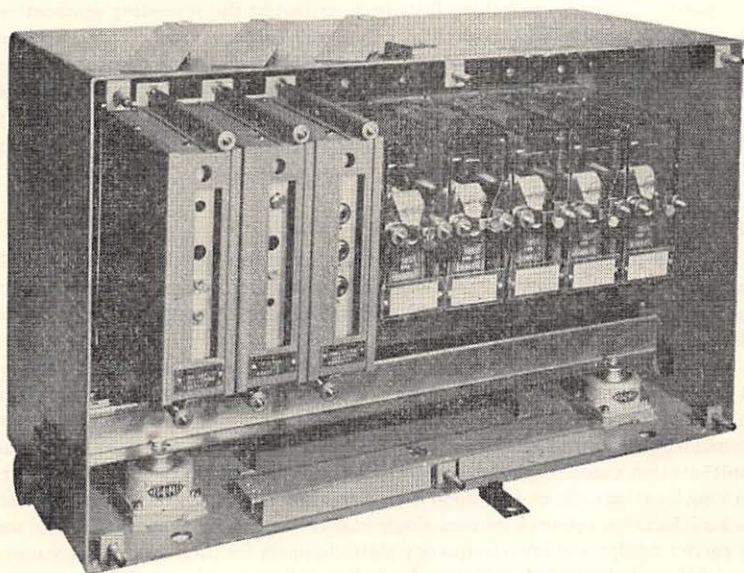
Modular construction of base, desk and miniaturized track diagram components of the machine permits many arrangements. It also facilitates modification or expansion of the control center.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Yard cab signal system.

A transistorized cab signal system has been developed which uses a single carrier channel to control simultaneously, but independently, four-aspect cab signals in as many as six classification yard locomotives. The carrier is imposed on a line wire, which extends from the control office through the area where cab signal control is desired. Inductive coupling between the line wire and a receiving coil on each locomotive transfers the carrier to the cab signal equipment on the locomotive. The locomotive mechanism is here illustrated.

Various combinations of 12 audio-frequency tones modulate the carrier to provide selective control of cab signal aspects. Since 12 tones are available,



the system has flexibility to meet the specific requirements of a wide variety of yard operations.

Three typical applications of the system, of which the latter two are now in service, are described:

1. Independent cab signal aspects can be displayed simultaneously in six locomotives. Two tones are assigned to each locomotive to control the four-aspect cab signal. The cab signal equipment on each locomotive responds to different tones separately or in combination. Any or all of the tones can be transmitted at the same time. Cab signals in locomotives not receiving their tones display red aspects.

2. Cab signal controls are transmitted simultaneously to four locomotives. One "call" tone and two "aspect" tones are assigned to each locomotive. The call tone selects the locomotive and lights the red aspect of the cab signal. The aspect tones change the red signal to the desired aspect. Cab signals in locomotives not selected remain dark. This arrangement permits the use of the call tone to switch the locomotive's radio to a pre-selected frequency, such as that used by hump locomotives. The radio equipment in locomotives not selected remains tuned to the general yard frequency.

3. Used in a dual-hump yard in which six locomotives are divided into two groups of three, the system permits simultaneous transmission of cab signal aspects to two locomotives, one in each group. One call tone is assigned to each locomotive, and a distinctive pair of aspect tones to each group of three locomotives. The call tone selects the locomotive and lights the red aspect of the cab signal. The aspect tones change the red signal to the desired aspect. Cab signals in locomotives not selected remain dark. A similar arrangement could, of course, be used to control cab signals in two groups of three locomotives working in a single-hump yard. The radio switching feature described in the preceding application is also available with this third cab signal arrangement. Transistorized locomotive equipment operates directly from locomotive control voltage. No special power supplies are needed. Tone generators in the office equipment are also transistorized. Power output stages are high-reliability type vacuum tubes. Office equipment operates on 115-volt, 60-cycle a.c.

This is a development of the General Railway Signal Co.

528 high speed code control system.

The 528 high speed code control system has been developed whereby all switch, signal and associated functions at a number of large railroad interlocking locations can be controlled from and indicated to a remote location or office over a two-wire line circuit.

The 528 code control system actually comprises two independent systems: (1) a multi-station control system for transmitting information from the office to the interlocking locations, and (2) a single-station indication system for transmitting information from the interlocking locations to the office. One multi-station control system can transmit information to one or more interlocking locations, depending upon their size, traffic density, etc.; but each interlocking location requires its own single-station indication system. By the use of carrier equipment (two frequency shift channels for each system) any number of these independent systems, depending only upon the available spectrum

width, can be operated over a single pair of line wires. Since these systems operate independently of each other, control and indication information can be transmitted concurrently.

The 528 multi-station control system provides for 32 stations with any desired number of two-position control functions per station, the number of functions being limited only by the maximum permissible code time. The system operates over a two-wire polarized d.c. line circuit at the rate of approximately 25 steps per second. A two-way selection is provided on each step by one or the other of the two line polarities. A basic code in this system consists of five station selection steps and 11 function positioning steps. Total code time, including starting and resetting periods, is approximately 1 second. This basic code, however, can be readily contracted to any desired number of function steps by merely omitting function assignments, or the code can be expanded to provide for additional function steps by the use of extension units. Where interlocking consolidations are so extensive as to require two or more control systems, each system in addition to the first will have its own separate polarized d.c. line section extending between its associated interlockings, but each system, more distant than the first, will be operated by two carrier channels over the two-wire d.c. line sections of the less distant systems.

The 528 single-station indication system is purely a stepping system which operates at approximately 25 steps per second and provides for the positioning of four indication functions per step, or 100 per second. The system requires two separate and distinct frequency shift carrier channels, one for producing stepping actions at the receiving location (office) in synchronism with the stepping actions at the transmitting location, and one for positioning the four indications per step. Any number of these indication systems, limited only by the available spectrum width, may be operated over the two-wire line sections of their companion control systems by providing two carrier channels for each system and band pass filters for joining the two-wire d.c. line sections.

Both of these systems are provided with features whereby the local equipment at any location can be transferred from automatic operation to manual operation and can then be hand-stepped at any desired speed.

The systems use Style KP and G relays and transistorized registry devices which are assembled in plug-coupled functional units for mounting on 19-inch communication type racks.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

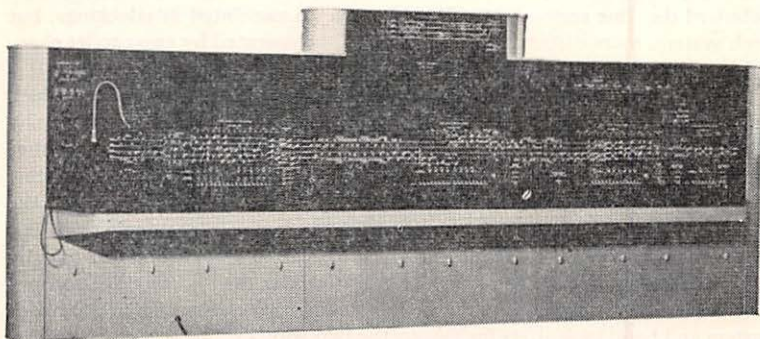
Acceptance as information.

NEW AND IMPROVED SIGNAL DEVICES AND
RELATED APPLIANCES*

It should be understood that this is solely a report to inform the members of the availability of the various devices mentioned therein, and what the manufacturers claim they will do. It is submitted as information and does not constitute any Signal Section recommendation.

Miniaturized route control machine.

A new Style UR route control machine, here illustrated, has been developed which is considerably reduced in size from that of previous models. This has been accomplished primarily by miniaturizing the control and indication features.



Both the control levers and the line-of-light indication units have been reduced in size so that they may be placed on the panel at one-half the former horizontal spacing between mounting centers, thus shortening the length of track model by nearly 50 per cent.

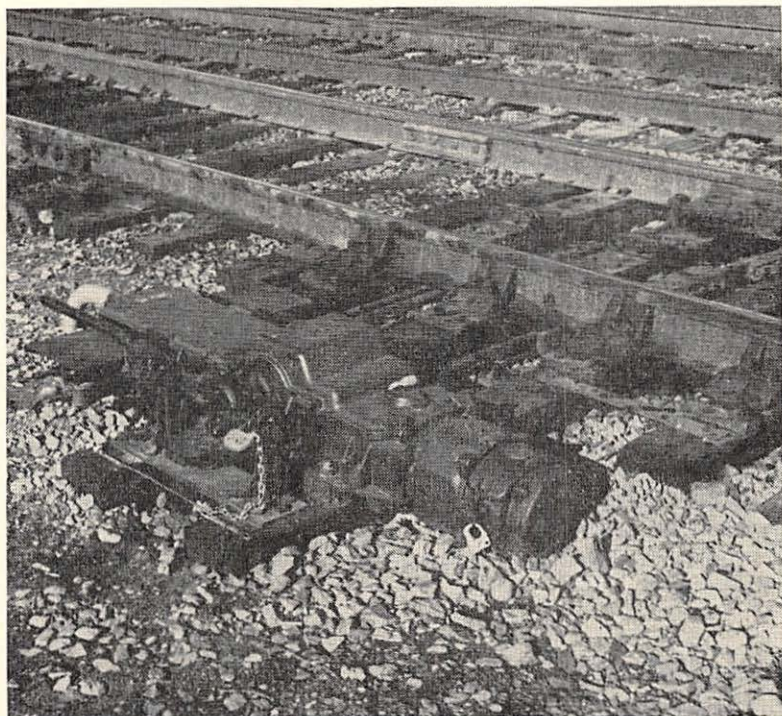
The line-of-light indication has been reduced in size by the complete redesign of the light boxes. Each box is a complete unit readily mounted or removed from the rear of the panel. A detachable cover permits the easy replacement of the lamps in the light boxes without disturbing the box assembly. Connections to the light box covers may be by solder terminals or by taper pin plug connection. The boxes may be adapted for use on either a sheet metal or formica panel by use of the proper indicating elements in their assembly. The miniature aircraft type lamp of the 300 series with flange base has been selected for use in the light boxes.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

* Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 206-A and 287-A.

Frost-protected switch machines.

New electric switch machines, designated Models 5E and 5F, provide simplified operation, reduced maintenance, and designed-in frost protection. They meet requirements for main-line service at single switches, double-slip switches, movable point frogs, and derails. The Model 5E machine is for power operation only. The Model 5F machine, here illustrated, is equipped with a dual-control mechanism, for both power and hand-throw operation. The machines are available for either $2\frac{1}{2}/32$ volt or 110-volt d.c. operation.



Control and overload relays are housed externally.

A new principle of magnetic detent is used to hold the motor armature against drifting from vibration. Magnetic flux linkage between a permanent ring magnet fixed in the housing cover and a similar magnet attached to the armature shaft holds the shaft securely after the dynamic snub stops the armature at the end of the stroke. Because there is ample clearance between the magnetic-detent elements, adjustments and replacements due to wear are eliminated, and frost cannot interfere.

A silicone-treated, moisture-repellent cover jacket keeps moisture off the motor commutator. A transparent shield above the commutator deflects any drip from condensation, protects against outside moisture when the compartment is open and allows visual inspection with shield in place. Because the shield is transparent, there is no interference with normal visual inspection.

The point detector contacts are knife-edged, and have $3\frac{1}{4}$ to 4 pounds pressure. Heavy duty motor control contacts carry and break motor current directly. The new design of the gear train in the Model 5F machine permits removal of the clutch without disassembling the dual-control mechanism. The machines are equipped with renewable box-style wear plates for the throw bar, and for the lock and detector rods.

These machines are developments of the General Railway Signal Co.

Direct-acting switch machine.

A Style DA-10 electro-pneumatic direct-acting switch machine for classification yards has been developed to provide faster action than was obtained with previous designs of direct-acting machines. This faster action permits a shorter length of detector track circuiting ahead of the switch points. In particular, it avoids the extension of the detector track circuit into an overlap with the retarder control track circuit.

Most of the improvement in the time of operation has resulted from a new style operating valve. The new valve is of the piston type rather than a slide valve and is similar to the valve used with electro-pneumatic retarders in automatic yards. The valve is mounted on the cylinder head. Improved magnet valve design permits the valve seats to be ground-in before being mounted.

The operating cylinder has been redesigned also to provide a better assembly and improved operation. One 5-inch diameter cylinder is used to supplant the 4 and 5-inch cylinders of the older style direct-acting machine. The new machine may be used to replace the older design machine since the mounting arrangement is identical.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Modular relay cabinet.

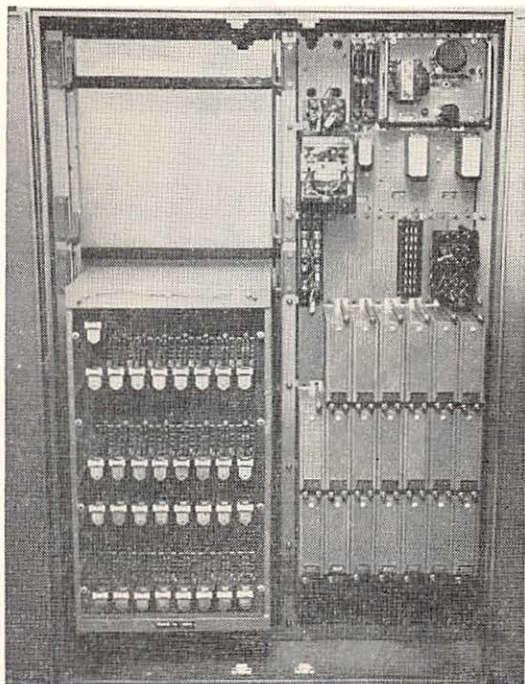
A new cabinet of modular design has been developed for housing Type A coding relays. The basic modular section has a capacity for eight relays. Sections are stacked when manufactured to provide total relay capacity required.

Addition of a top and a bottom, the same for all cabinet sizes, completes the basic structure. A typical assembly is here illustrated.

Relays are protected by a Plexiglas cover held by turn latches. Covers are available to fit the various possible sizes of cabinets, and can be sealed in place.

A Faston connector of the honeycomb type is mounted on the back of the cabinet to provide plug-in connection of associated wires.

Where desired, a bracket can be attached to the cabinet top for mounting Type B plugboards and relays. The same bracket may be used for mounting



the Faston connector to meet clearance requirements when the cabinet is to be used on a slide drawer in a sectional-type control machine.

Modular cabinets can be shelf or rack mounted.

This is a development of the General Railway Signal Co.

Transistorized carrier telephone.

A new carrier telephone, here illustrated, has been developed to provide a portable, self-contained, battery powered unit with transistor circuitry in a convenient, compact size. The over-all case dimensions are 2 inches by $4\frac{7}{8}$ inches by 11 inches. The weight of the unit, including batteries and shoulder strap, is approximately 5 pounds.

Each telephone unit is assembled in a rugged two-part molded plastic case. Two 8-volt mercury cell batteries provide the power supply for at least 40 hours of actual transmission and have excellent shelf life. The units are available in carrier frequencies of 30 kilocycles and 35 kilocycles. The transmitter output is +25 dbm. Receiver sensitivity is -20 dbm. Satisfactory communication between two of these units has been obtained over as much as 75 miles of line.

These telephones are intended primarily for direct connection across CTC control lines. They may be used over line or control wires or from line to ground.



This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Style FR Hi-Shunt track circuit.

A Style FR Hi-Shunt track circuit has been developed to overcome shunting difficulties due to oily rail and wheel film in short detector track circuits. The circuit was developed particularly for use in automatic classification yards, but may be used for any short detector track circuit where a high degree of shunting sensitivity is required. This track circuit unit provides unusually high inter-rail voltage for breaking through rail film, quick shunting and momentary loss of shunt protection, has low power requirements, and is simple to install and adjust.

The equipment for this track circuit consists of a Style FR Hi-Shunt track unit and a double coil d.c. biased track relay of suitable characteristics with an associated adjusting resistor and diode to provide the desired timing characteristics. The track unit includes a ferroresonant circuit which is energized directly from the a.c. power supply and a transformer-rectifier combination to energize the d.c. track relay. This unit is mounted in a case, similar to a track transformer, measuring $4\frac{3}{4}$ inches wide, $9\frac{1}{4}$ inches long and $7\frac{5}{8}$ inches high when shelf mounted.

The ferroresonant circuit consists of a capacitor in series with a transformer primary acting as a non-linear reactor. The track circuit is fed from a secondary winding on this transformer.

This type of ferroresonant circuit has the characteristic of providing a substantially fixed voltage to the rails when shunted by any resistance greater than a critical value. This critical value is chosen as slightly lower than the

minimum ballast resistance anticipated for the track circuit. When shunted by any lower value of resistance the rail voltage falls off rapidly.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Style PN-150 and PN-250 plug-in relays.

The PN-150 line of plug-in d.c. relays has been expanded to include new types not previously available and also a line of double-width relays designated PN-250. The PN-250 series provides for special purpose relays and a greater number of contacts.

New types in the single-width PN-150 series are the PN-150BM biased switch control relay, PN-150SO switch overload relay, PN-150BC special biased relay for use as a decoding relay, PN-150BL light-out relay, PN-150BH high release biased track relay, PN-150BE high efficiency biased relay, PN-150NE high efficiency neutral relay, and PT-150 thermal time element relay.

Relays available in the double-width PN-250 series are the PN-250B biased relay, PN-250BE high efficiency biased relay, PN-258B slow pick-up ordinary release biased relay, PN-258BSR slow pick-up slow release biased relay, PN-259BSR long time element slow release relay, and PT-250 electromagnetic time element relay. The PN-250B relay is equipped with 6FB-6F-3B contacts and the PN-250BE, PN-258 and PN-259 relays have 6FB contacts.

The PN-150BM relay is equipped with two front magnetic blowout heavy duty contacts. It may be used in combination with the PP-151 magnetic stick relay to provide polarized circuit control of switch machines of any voltage.

The PT-250 electromagnetic time element relay has a self-contained pendulum to regulate the timing. It features a new magnetic clutch of high holding force with metallic engaging surfaces. Relays are available with two time contacts and one checking contact in time ranges of 24 seconds to 4 minutes and 1 minute to 10 minutes. Also available is a relay with three time contacts and one checking contact with a time range of 2.5 seconds to 25 seconds.

These relays are developments of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Style G relay.

A new Style G relay has been developed to perform non-vital functions in signaling systems such as centralized traffic control, route interlocking and automatic switching. This relay is faster in operation and has lower power consumption than relays previously used for this service. The relay can be furnished in six sizes with a maximum of 16 transfer contacts or 48 contact springs. There has been no sacrifice of reliability.

The Style G relay uses a relatively flat "E" magnetic structure and a flat trunnionless armature. The contacts are arranged in two rows. The number of contacts is increased simply by increasing the height of the contact stacks. The entire assembly is held together by a single bolt that passes through the center of the stack insulators. Contacts are held at the front end by two insulating ladders, one fixed and the other movable. These ladders position and drive the contacts.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Hinged rear door for instrument case.

The Style RS sheet steel instrument cases have been improved by the use of hinged doors on the rear as well as on the front of the case. This change is to provide more ready access to the rear of the instrument case, which is particularly desirable where relays of the plug-in type are used. The rear doors were formerly bolted to the case without the use of hinges.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

Acceptance as information.

COMMITTEE XI—ELECTRONICS

Personnel

J. M. Hesser, Chairman

J. Ryscuck, Vice-Chairman

P. B. Burley

H. H. Dofka

C. H. Dunn

J. J. Eash

H. J. Foster

B. Freeman

W. B. Garrison

G. M. Hill

J. E. Hillig

J. M. Hoover

B. L. McNeill, Jr.

J. T. Parker

N. W. Stickney

D. H. Thomsen

R. B. Haner*

P. H. Luft*

L. R. Thomas†

Signal Section, AAR:

The following outline of work has been assigned:

1. Revision of Manual.
2. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.
3. Investigate and report on the use of electronic controls for railway signaling.
4. Report on electronic measuring apparatus applicable to railway signaling.
5. Principles of vacuum tubes, carrier systems and other electronic systems and devices.
6. Recommend basic design principles for electronic controls for railway signaling systems.
7. Investigate and report on the effects to both signal controls and communication when signal circuits and communication circuits are operated on the same wires or other media, collaborating with AAR Communications Section Committee 3.
8. Electron tubes for use in signal apparatus, recommendation to cover types and designations of tubes to meet various requirements.
9. Investigate and report on the use of electronic switches in lieu of electromagnetic relays.
10. Investigate and report on the attenuation of open wire pairs and of cable pairs at frequencies up to 100 kilocycles, collaborating with AAR Communications Section Committee 3.
11. Investigate and report on apparatus and methods for inspecting and testing carrier and other electronic equipment used in railway signaling, collaborating with Committee III.

* Consulting Member.

† Consulting Member from Communications Section, AAR.

12. Recommend transposition schemes for paired wires for voice or carrier frequencies, collaborating with AAR Communications Section Committee 1.

13. Investigate and report on apparatus and methods used to measure speed and acceleration by radar for railroad operation.

14. Investigate and report on electronic devices for the detection of hot boxes, interconnected with signal systems.

15. Investigate and report on rules and regulations governing the use of radio for signaling purposes.

16. Investigate and report on the use of transistors or other similar devices for signaling purposes.

17. Explanation of the decibel, its measurement and application to carrier frequencies used in signaling.

18. Investigate and report on the use of electronic or other similar devices that may be used for car identification.

The committee submits for consideration, reports on the following subjects*:

3. Frequency-shift transistorized equipment.

Audio frequency overlay equipment for highway crossing application.

Frequency-shift carrier applied to traffic controls and indications.

7. Joint use of line wires for communications and signals.

9. Electronic registry unit.

Unijunction transistor.

14. Application of electronic devices for the detection of hot boxes.

Electronic device for the detection of hot boxes.

16. Transistorized unit carrier.

Cooperative report. Communications Section, AAR, Committee 4—Radio and Allied Communications.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

JOINT USE OF LINE WIRES FOR COMMUNICATIONS
AND SIGNALS*

A 150-mile installation of centralized traffic control (CTC) with 35 controlled locations is now in service on the Southern Ry. System between Greenville, S. C. and Atlanta, Ga. The CTC code line between the control office at Greenville and the controlled locations is an underground cable made up of a pair of No. 10 copper conductors, polyethylene insulation, a metal tape wrap, and a polyvinyl insulating jacket. Attenuation is approximately 0.33 db/mile, and impedance is 160 ohms at 1,000 cycles per second.

The code line handles simultaneously d.c. control codes for CTC, two carrier channels for CTC indications, and a maintainers' telephone circuit. To provide these services over cable in a system of this size and length required repeaters for all information transmitted. One CTC code repeater, four CTC carrier repeaters and three voice repeaters are used. Figure 1 shows the location of and distances between the various repeater stations.

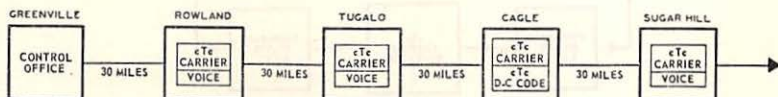


Fig. 1.
Geographic Location of Repeaters.

In CTC systems of the Syncroscan type used in this installation, two carriers are involved (1) a synchronizing carrier (typically 8.5 kilocycles) outbound from the control office, and (2) an inbound indication carrier (typically 6.5 kilocycles). Figure 2 shows a standard arrangement for repeating Syncroscan carriers where necessary, with d.c. codes and voice frequencies running through.

The code line is broken at the repeater location, and a separate frequency-conscious path across the break is provided for each service on the line. The CTC carriers are coupled to separate narrow band one-direction repeaters through 6.5 kilocycles and 8.5 kilocycles band pass filters, amplified, and sent on in the correct direction, again through appropriate filters. The CTC d.c. code is bridged around the repeater location through a code pass filter with range from d.c. to about 50 cycles per second, while the voice circuit is bridged through a 300 to 3,000 cycles per second filter.

In this installation, voice-circuit repeaters are used in addition to carrier repeaters. Figure 3 illustrates the arrangement. For the CTC d.c. codes and CTC carriers, the plan is the same as described in the preceding paragraph. The voice circuit, however, is now amplified in both directions by a Western Electric Type V-1 repeater. This was modified for the service by providing special balancing networks for each hybrid, since the equipment was not designed for use on cable.

At one location (Cagle, Fig. 1) a regenerative d.c. code repeater is included with carrier repeaters, as shown in Fig. 4. At this location, the d.c. code is received from the control office, regenerated, and put back on the line through

* Previous report on this subject appears in AAR Signal Section 1951 Proceedings, Vol. XLIX, pp. 304 and 355.

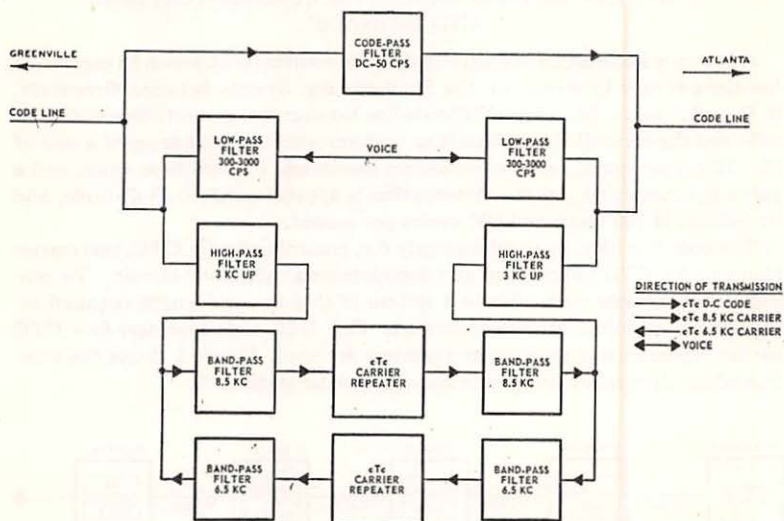


Fig. 2.
Circuit Organization for CTC Carrier Repeater Location.

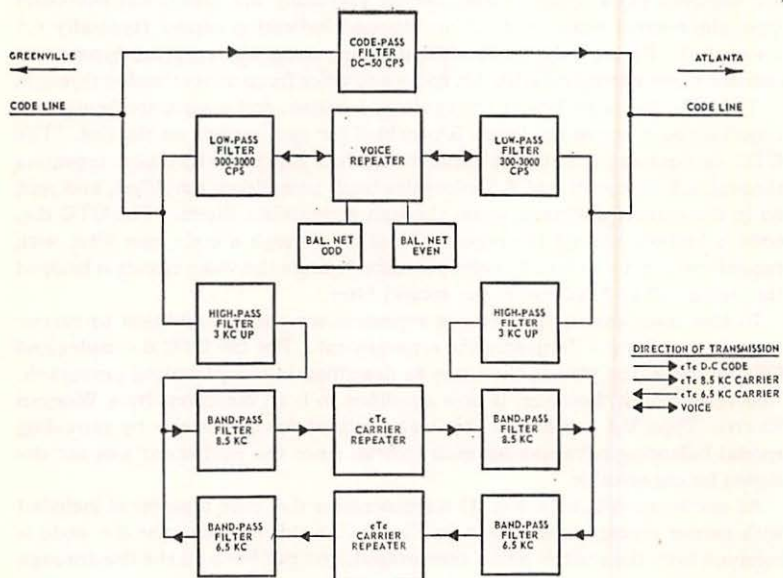


Fig. 3.
Circuit Organization for CTC Carrier and Voice Repeater Location.

a code pass filter. Energy for the regenerated code is obtained from a local line power supply. The code pass filter gives proper shape to the d.c. code characters and eliminates components above 50 cycles per second which would cause interference in the voice and carrier circuits. The same technique is used at the control office where the d.c. code is originally placed on the line.

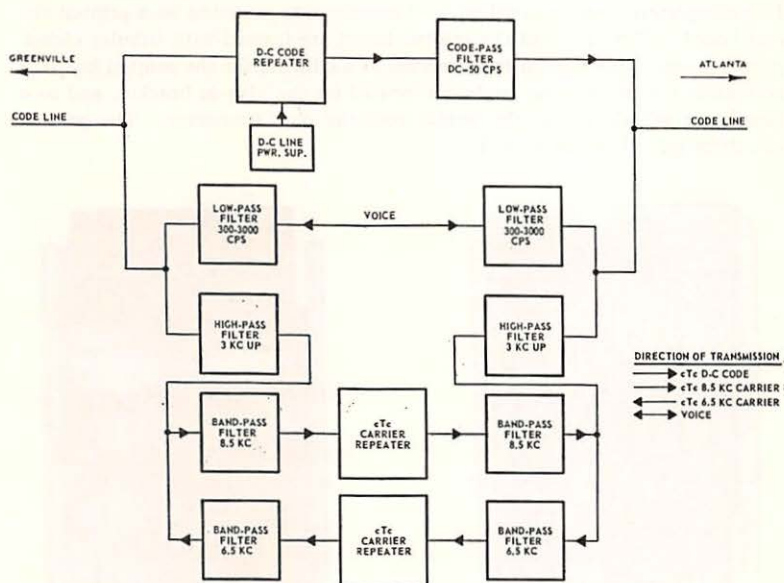


Fig. 4.
Circuit Organization for CTC Direct Current Code,
Carrier and Voice Repeater Location.

This installation successfully provides a good quality voice circuit over a long underground CTC line without interference to or from the signal services. A notable feature of the installation is the complete elimination of overhead signal wires. In addition to the underground CTC code line, this involved the use of Trakode coded track circuits for signal control, burial of local wiring (in the same trench with the cable) and connection to commercial sources for power wherever needed.

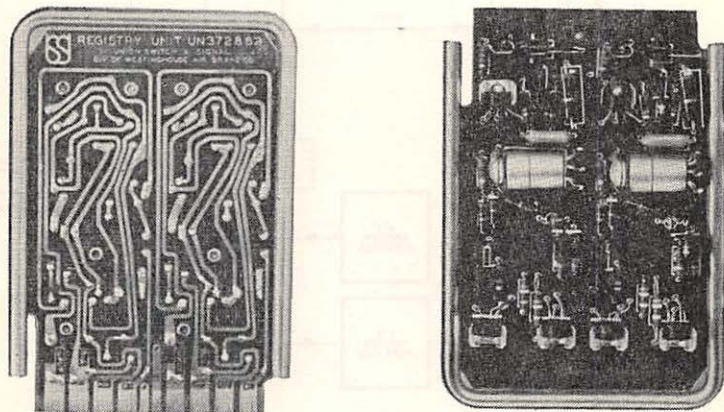
Action Recommended

Acceptance as information.

ELECTRONIC REGISTRY UNIT

An electronic registry unit that can be triggered by pulses of less than 0.10 milliseconds and then function to pick up a relay with over a watt of available power has been developed. The unit thus acts as an electronic switch.

The unit is constructed in plug-in module form with two units on each board. It is completely transistorized with all components mounted on a printed circuit board. Three sides of the printed board are framed with tubular nickel-plated brass. This tubular frame serves as a stiffener for the printed board, a receptacle for an indexing guide pin located on the plug-in bracket, and as a handle for withdrawal of the board from the plug connector. The printed circuit board is here illustrated.



The circuitry consists of a bistable flip-flop pair of transistors which are actuated by the triggering voltage, and intermediate buffer-amplifier stage, and a power stage that functions to turn on the current to the relay coil. The bistable and intermediate amplifying stage comprises three PNP transistors and the power stage one NPN type. Complete temperature compensation from minus 30 to plus 150 degrees Fahrenheit is provided.

The unit can be triggered to either the cut-off or conducting state by application of a positive or negative triggering voltage that can be a plus (B) or minus (N) voltage from the supply terminals of the unit. Thus, a separate battery supply for triggering purposes is not required. This is made possible by biasing networks on the bistable network and on the intermediate amplifier. The units have been provided with a single input lead for triggering purposes. Triggering is accomplished by alternately applying B or N to this input wire.

The circuit action of the registry unit can be described as follows:

1. B is applied for 0.1 millisecond to the input trigger wire.
2. The bistable circuit assumes a position with one transistor conducting and one cut off.
3. The cut-off transistor causes a bias to be developed on the intermediate amplifier that turns this transistor on. This PNP transistor then supplies base current to the NPN power transistor. This base current

is amplified through the power transistor (due to its d.c. beta gain) by an amount that is sufficient to pick up a relay.

4. B can be removed after applying the initial trigger pulse but the bistable pair stays in the previously positioned state until N is applied to the trigger wire. When N is applied, the transistors in the bistable pair reverse states and this effects cut-off of current to the relay coil.

The registry unit was developed for use in the 528 High Speed Code System, described in report of Committee X—Signaling Practice, p.184. In this application it is used for indication purposes and normally operated during the overlap transfer time of a relay that may be operated at a rate of 30 cycles per second.

The unit was designed for nominal 16-volt operation with an allowable variation of from 14 to 20 volts. Power consumption is essentially the power required by the relay in the pick-up state and less than 0.2 watt in the de-energized state.

This is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

Acceptance as information.

UNIUNCTION TRANSISTOR

The unijunction transistor is a three-terminal semi-conductor with a negative resistance characteristic. Thus, like the point contact transistor, it has two stable states, one conducting and the other non-conducting. It is unlike a conventional transistor, however, in that it has only a single junction as compared to two junctions in the conventional three-terminal transistor. From this feature the name "unijunction" is derived.

The maximum outside diameter of the transistor is 0.345 inch and the maximum height, exclusive of leads, is 0.245 inch.

The transistor is constructed from an N type silicon bar to which is affixed a P type terminal as shown in Fig. 1.

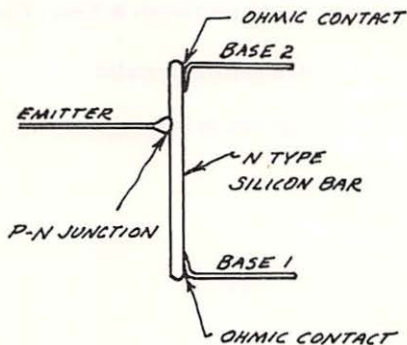


Fig. 1.
Construction.

Ohmic contacts are made at the opposite ends of the bar and on the opposite side from the P (emitter) contact and these are referred to as base 1 and base 2 contacts. The emitter is mounted closer to base 2 than base 1. The equivalent circuit of the unijunction transistor is shown in Fig. 2.

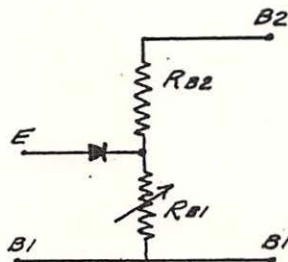


Fig. 2.
Schematic Diagram.

In normal use, a battery supply voltage referred to as V_{BB} is placed across base 1 and base 2 with base 2 being positive. With no emitter current flowing, the bar of N type silicon acts like a simple voltage divider with a voltage proportional to the length from E to B_1 as compared to B_2 to B_1 appearing at terminal E. A small interbase (base 1 to base 2) current will flow of a magnitude determined by the interbase resistance and supply voltage. As long as the magnitude of voltage applied to E externally does not exceed the voltage applied internally through divider action, the P-N junction will be reverse biased and no emitter current will flow.

When the voltage applied to the emitter becomes positive and larger in magnitude than the divider voltage, the P-N junction becomes forward biased and emitter current will flow. The flow of this emitter current from the emitter to base 1 causes a reduction in resistance between these electrodes so that as the emitter current increases, the voltage decreases. A plot of a typical curve of emitter voltage versus emitter current is shown in Fig. 3. Since a straight line drawn tangent to this curve at say 2 milliamperes has a negative slope (downward and to the right) the device exhibits a negative resistance characteristic. It is noted that beyond the point marked valley a positive resistance characteristic is exhibited. The region to the right of this valley point and the region to the left of the location marked peak point represent the two stable regions of operation. As soon as enough current is introduced in the emitter to satisfy this peak point value, the unijunction will trigger from the non-conducting to the conducting state.

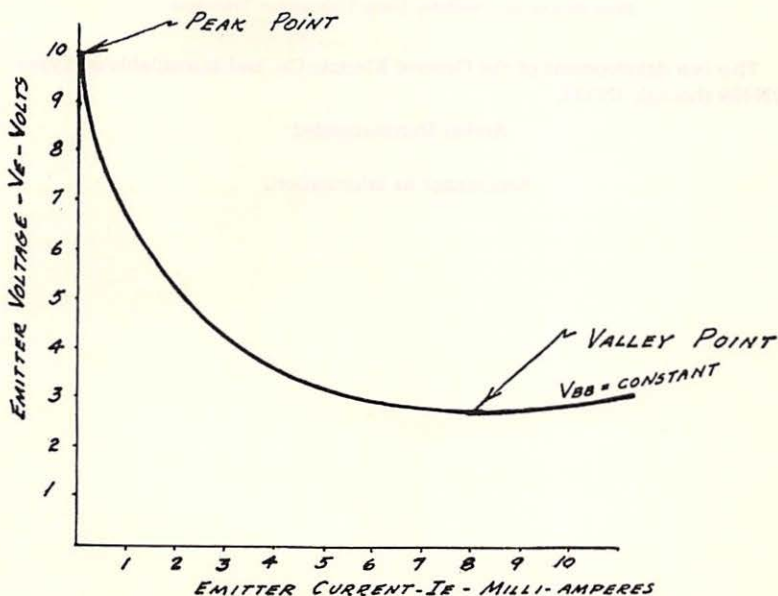


Fig. 3.
Typical Emitter Characteristic—Unijunction Transistor;

The unijunction transistor's chief usefulness lies in application to oscillator, timing and bistable circuits. Its application in a simple relaxation oscillator circuit is shown in Fig. 4. (It is noted that the symbol is unlike that of a conventional transistor.) The basic requirements for oscillation in the circuit is that R_1 is small enough to allow peak point current to flow but large enough to prevent the valley (current) point from being attained. Oscillation is thus achieved as the circuit fires to discharge C_1 then returns to the peak points as C_1 recharges through R_1 . The waveforms present at several points are shown in Fig. 4. The frequency of oscillation is primarily determined by the values of R_1 and C_1 .

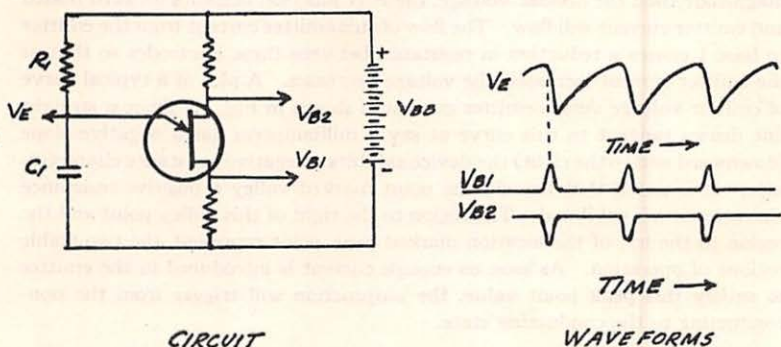


Fig. 4.

Basic Relaxation Oscillator Using Unijunction Transistor.

This is a development of the General Electric Co. and is available in Types 2N489 through 2N494.

Action Recommended

Acceptance as information.

FREQUENCY-SHIFT TRANSISTORIZED EQUIPMENT

Frequency-shift transistorized (FST) equipment has been designed to fulfill a need for narrow band frequency-shift transistorized carrier equipment that is adaptable to either traffic control systems or teleprinter service.

This equipment, illustrated in Figs. 1 and 2, is completely transistorized and panel-mounted for application to a standard communications rack. A combined transmitter-receiver panel is referred to as Style H and the components on the panel are arranged as shown in Fig. 1. The operating frequency is determined by plug-in units and the same basic panel is used for all frequencies. Printed circuits have been used throughout.

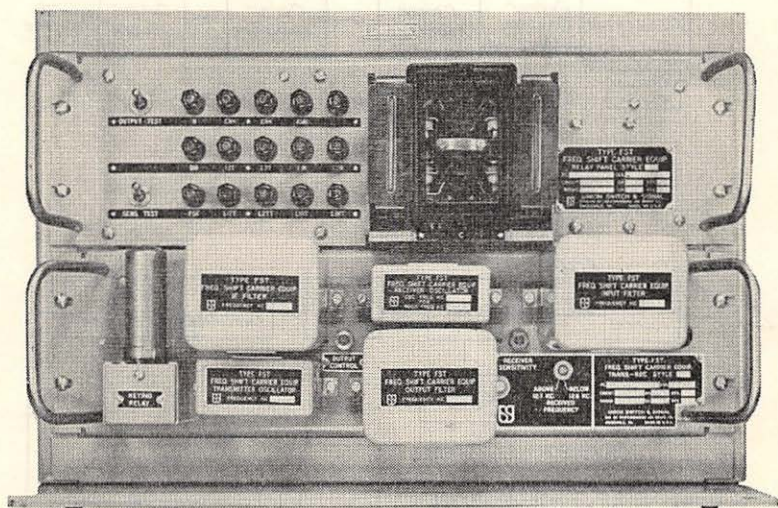


Fig. 1.

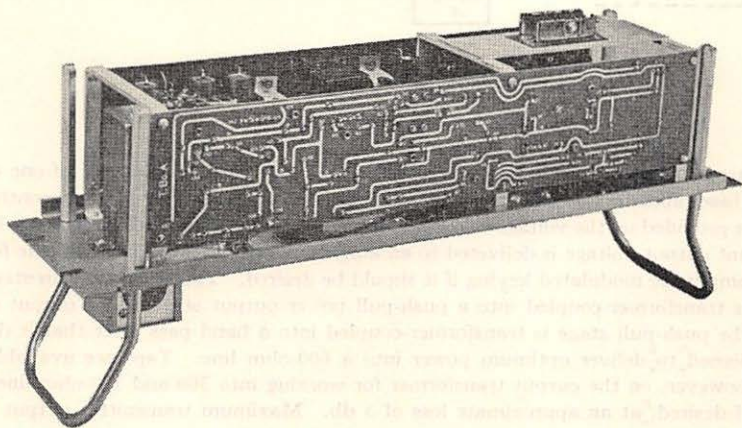


Fig. 2.

The transmitter generates carrier that may be frequency-shifted by a keying relay at a rate of up to 50 cycles per second for application to the line. The frequency shift is plus or minus 75 cycles from a mythical center frequency making the total frequency excursion 150 cycles. Adjacent channel center frequencies are 500 cycles apart in the frequency range from 7 to 26 kilocycles so that 39 channels are presently available with a minimum adjacent channel frequency difference of 350 cycles.

The transmitter comprises an oscillator unit, consisting of a transistor and toroidal tank coil, which is capacity tuned to the associated frequency. A block diagram for the transmitter is shown in Fig. 3. The tuning capacitors

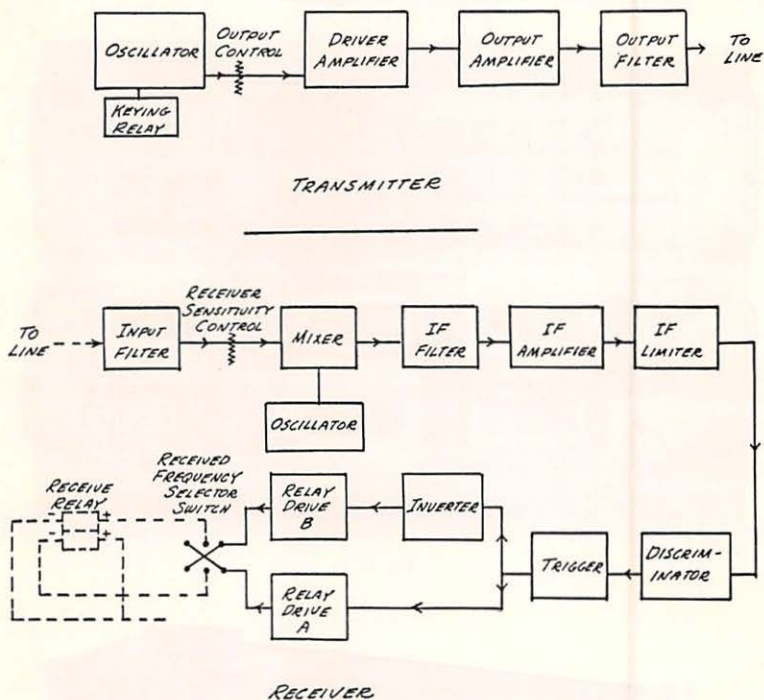


Fig. 3.

are arranged in combination across the tank coil and the shunting of one of these capacitors by a keying relay serves to shift the frequency. A gain control is provided on the voltage take-off winding of the oscillator coil and the resultant output voltage is delivered to an amplifying stage. Provision is made for amplitude modulated keying if it should be desired. The output of this stage is transformer-coupled into a push-pull power output stage. The output of the push-pull stage is transformer-coupled into a band pass filter that is designed to deliver optimum power into a 600-ohm line. Taps are available, however, on the output transformer for working into 300 and 100-ohm lines, if desired, at an approximate loss of 3 db. Maximum transmitter output is +18 dbm.

The receiver is a superheterodyne consisting of an input filter, oscillator stage, mixer stage, IF filter, IF amplifier stage, IF limiter stage, discriminator stage, trigger stage, inverter stage, and two relay drive stages. A block diagram illustrating operation of the receiver is shown in Fig. 3.

The heterodyne principle is employed to produce a relatively low IF frequency on which filtering can be more easily accomplished. As the receivers may operate to -40 dbm and the transmitters to +18 dbm, the receivers must possess a rejection of 58 db to the adjacent channel.

The input filter is a band pass type with relatively narrow band pass characteristics. A volume control is provided at the output of this filter for setting the desired operating level. The line signal is applied from this volume control to a mixer-amplifier along with a signal from the local oscillator. The output is then transformer-coupled into an IF band pass filter stage tuned to the center frequency.

The output of the IF filter is amplified and the signal transformer coupled to a limiter stage. The limiter functions to hold the output constant regardless of the receiver level. The output of the limiter is applied to the discriminator whose output is used to trigger a bistable flip-flop circuit to one of two states.

The output of the bistable or trigger circuit is used to control a transistor that drives relay A directly as shown in Fig. 3. This output is also applied to an inverter which controls a transistor that, in turn, drives relay B directly. Actually relay A and relay B are two coils of the same polar stick relay so that when the A drive circuit is energized the relay is moved to its normal contacts and when the B drive circuit is energized the relay is moved to its reverse contacts.

A transistorized regulator that maintains the battery supply voltage constant over a wide variation in voltage is provided on the Style H combined transmitter-receiver panel.

There is also available a Style M repeater terminal which consists of two repeater amplifiers, one for operation in each direction. The repeater terminal is also designed for standard rack mounting.

The equipment is designed for operation from a 16-volt battery and the power consumption is approximately $5\frac{1}{2}$ watts. The equipment may be operated through a temperature range of minus 35 to plus 165 degrees Fahrenheit.

This equipment is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

Acceptance as information.

AUDIO FREQUENCY OVERLAY EQUIPMENT
FOR HIGHWAY CROSSING APPLICATION

Audio frequency overlay (AFO) equipment that completely eliminates the need for insulated joints has been developed for control of highway crossing circuits.

This equipment is similar in principle of operation to the AFO equipment covered in report presented at the 1956 Annual Meeting (AAR Signal Section 1955 Proceedings, Vol. LIII, p. 169-A). It is completely transistorized, operates from a nominal 10 or 12-volt source, and can be overlaid on existing signal circuits. The component parts necessary for a highway crossing installation include the transmitter, the receiver and the receiver relay.

The arrangement of transmitters and receivers for single-track double direction running highway crossing territory is shown in Figs. 1 and 2. The configuration shown in Fig. 1 is used for approach distances up to 2,500 feet in length while the configuration shown in Fig. 2 is used for approach distances from 2,500 to 4,000 feet in length. The transmitters, each of a differing frequency, are connected from rail to rail at the desired approach distance from the crossing. The receivers are connected from rail to rail in conventional fashion in Fig. 1. In Fig. 2 the receivers are shown connected to a loop placed inside the rails. The receivers in this latter case are operated from voltage induced in the sides of the loop parallel to the rail from AFO current flow in the rails. This configuration was found essential for circuits ranging from 2,500 to 4,000 feet in length to provide 0.06-ohm shunting sensitivity.

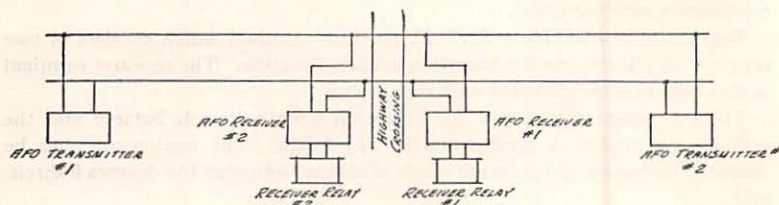


Fig. 1.
AFO Connections for Approach Circuits Up to 2,500 Feet.

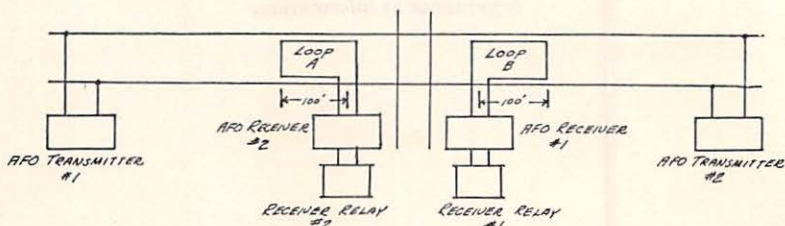


Fig. 2.
AFO Connections for Approach Circuits From 2,500 to 4,000 Feet.

To describe the action of the circuit under a train movement, it is to be understood that the receivers in both Figs. 1 and 2 are normally energized (receiver relays picked up) with the track unoccupied. The action will be described for Fig. 2, although the sequence of events for Fig. 1 circuit is exactly the same. The arrival of a train from the left shunts transmitter 1 when the train is 100 to 200 feet away and de-energizes receiver 1 and its associated relay. Receiver 2 is then de-energized as the front axles pass through loop A. As the last axle of the train passes through loop B, it greatly increases the flow of current in the section of rail to which the loop of receiver 1 is coupled and this receiver is again energized to pick up receiver relay 1. This cuts off the receding ringing of the highway crossing circuit. Receiver 2 is not energized until the last axle is several hundred feet past transmitter 2 at which time the circuits are completely reset to normal. It is evident that the circuit action is the same in either direction and it is also evident that the overlap of the two circuits present the equivalent of the conventional "island" track circuit.

In Fig. 2, AFO current flow is maintained in the rails at all times under unoccupied conditions by design of the transmitter output circuits. The output circuit provides a path for the energy that is generated by the transmitter at the opposite end of the circuit. This is important, for a path must be provided for current flow under extremely high ballast resistance conditions.

Two types of transmitters are used, one type of which is for application to approach circuits of 2,500 feet or less and the other of which is for application to approach circuits from 2,500 to 4,000 feet. These are referred to as the "low-power" and "high-power" types respectively. The high-power transmitter, illustrated in Fig. 3, is capable of delivering over a watt of power to the track circuit, and this is accomplished by the use of push-pull power transistors driven from an oscillator-amplifier network. The low-power transmitter furnishes several hundred milliwatts of power and is comprised of an oscillator-amplifier network that drives a pair of low-power transistors connected in push-pull. Both transmitters have a feed-back circuit that functions to produce a

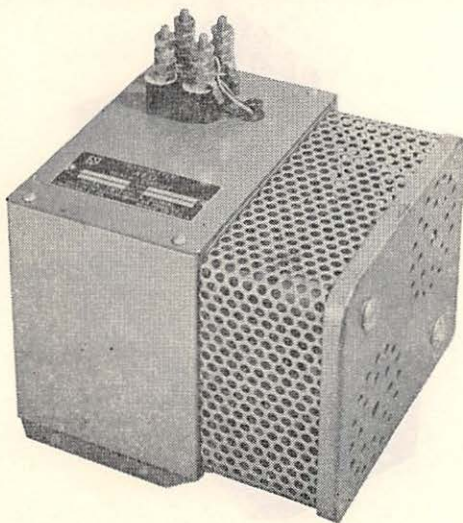


Fig 3.

relatively small output voltage to the track circuit under light load or high ballast resistance conditions and a relatively large output voltage that peaks at the heavy load or low ballast condition. This feed-back circuit is provided so that the standard 0.06-ohm shunting sensitivity will prevail on all circuits and it is checked so that loss or derangement of any associated component will result in a reduction or loss of signal on the associated receiver. Circuit design permits the transmitters to be operated through a temperature range of minus 30 to plus 150 degrees Fahrenheit with little change in output voltage.

The receiver, illustrated in Fig. 4, has an input impedance of approximately 1.5 ohms and a maximum sensitivity of approximately -20 dbm. Sufficient amplification is provided by use of transistor amplifying stages to increase the input level to approximately 100 milliwatts for operation of a relay. The output of the power stage is transformer-coupled to a full-wave rectifier, the d.c. terminals of which are taken to output terminals on the unit. A number of highly selective tuned stages function to give the receiver immunity to signals other than the one to which the unit is tuned. These stages also provide immunity to a.c. voltages that may be developed across the battery supply. An input sensitivity control has been provided that enables the sensitivity to be set in any of three ranges, with a fine control in each range. This control has been designed in the circuit so that complete or partial loss will result in relay drop-away. The receiver is temperature compensated so that the sensitivity is essentially constant from a temperature of minus 30 to plus 150 degrees Fahrenheit.

Design principles have been used throughout the receiver to provide for self-checking by relay drop-away if a receiver component should fail. These self-checking design features, as well as other inherent safety features, permit the receiver to be used in a vital highway crossing circuit without the necessity of coding except in propulsion territory.

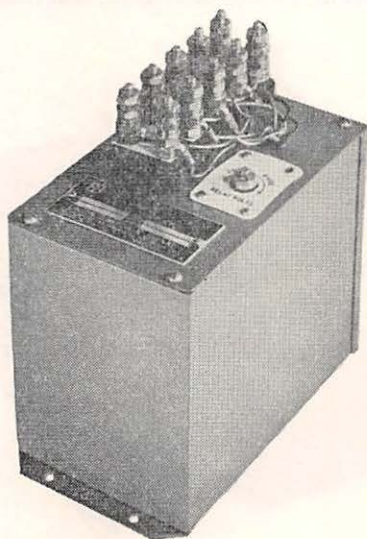


Fig. 4.

The equipment has been designed for operation on as many as nine channels in the frequency range of 1 to 3.05 kilocycles.

Power consumption is approximately 5.5 watts for the high-power transmitter and 0.3 watt for the low-power type. Receiver power consumption is 0.3 watt. High-power transmitter over-all dimensions are $9\frac{1}{4}$ by 8 by $8\frac{3}{16}$ inches exclusive of the AAR four-way terminal block provided on the top plate. Low-power transmitter over-all dimensions are identical to those of the receiver and are $4\frac{11}{16}$ by $9\frac{3}{16}$ by $9\frac{1}{4}$ inches exclusive of the AAR terminal block provided on the top plate. All units are adapted for either wall or shelf mounting.

This equipment is a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

Acceptance as information.

FREQUENCY-SHIFT CARRIER APPLIED TO
TRAFFIC CONTROLS AND INDICATIONS

There is available a frequency-shift carrier, which equipment while primarily designed for teleprinter (or telegraph), telemetering and load control systems, has successfully been adapted to a traffic control system. On one application, the equipment is being used to control and receive indications for a remote section over a pair of wires used as a dispatchers telephone circuit, upon which there are also d.c. traffic control codes and a Type C carrier.

This equipment utilizes the frequency spectrum (3325-9570 cycles per second) from which 20 separate channels are available. Three basic types of operation, all frequency modulation or frequency-shift techniques, are employed. Impulse type telemetering, teleprinter operation, telegraph and remote control all employ a frequency of 50 cycles per second above the assigned carrier channel center frequency for the "off" or "space" signal. For the "on" or "mark" signal, the frequency is shifted to 50 cycles per second below assigned center frequency. The channel center frequencies are spaced 250 cycles per second apart. Each channel occupies a band width of 100 cycles per second.

The components of carrier terminal consist of the required number of dual-channel transmitter chassis, dual-channel receiver chassis, differential squelch receiver chassis and an all-purpose power supply chassis.

The transmitters are basically a frequency modulation transmitter; the carrier transmitter includes an oscillator circuit employing a high-Q toroidal coil and selected temperature stabilized silver-mica capacitors for frequency stability. A reactance modulator provides the required frequency modulation deviation and maximum deviation limiting without introducing amplitude modulation. A limiting amplifier and a power output amplifier complete the channel.

Like the transmitter, the receiver is a dual-channel unit with interchangeable frequency determining elements and plug-in adapters for the specific data being handled. At the input to the receiver, a high impedance attenuator provides the connection to the 500/600-ohm line with minimum bridging loss. Following the attenuator, a plug-in band pass filter, similar to, but more selective than, the transmitter filter, accepts all signals within the channel with less than 3 db attenuation. However, more than 63 db attenuation is provided for signals in the adjacent channel.

Both the plate and filament voltages are furnished by a single type of power supply. One power supply chassis will accommodate as many as 10 transmitter or receiver chassis. The input to the power supply chassis is 117 volts, 50/60 cycles. Transformer taps are provided for normally low (105 volts), and normally high (125 volts) line voltage as well as the nominal 117 volts. Metallic rectifiers are used in the plate voltage circuits.

For those applications where an exceptionally high degree of signal reliability is required, a differential squelch receiver can be employed. The squelch receiver chassis contains one signal channel plus the squelch circuitry.

This is a development of Motorola Communications & Electronics, Inc.

Action Recommended

Acceptance as information.

APPLICATION OF ELECTRONIC DEVICES
FOR THE DETECTION OF HOT BOXES

Investigation developed that a number of electronic hot box detectors have been installed but there are only two installations at this time that are interconnected directly with a signal system. These are strictly on an experimental basis and no information is available on their performance.

In attempting to get a more complete report on this subject the following data has been assembled regarding detectors now in service, not directly connected to a signal system, which it is believed will be of interest to the members:

Installations.

Nine railroads report a total of 31 detectors in service with plans for installing 94 additional units. The detector furnishes information to the operator located at a control point. On eight roads, the operator can stop the train by means of a wayside signal if a hot box is detected. One road reports that the train crew is notified of a hot box by radio.

Performance.

One road reports a detector was installed on December 1, 1956 and detected a total of 62 hot boxes as of October 31, 1957. A second unit was installed on October 31, 1957 and detected a total of 30 hot boxes as of October 31, 1958.

One road reports a detector placed in service on January 24, 1958 had recorded 96 hot boxes as of August 30, 1958. Of these, 57 were set out and nothing was found wrong on 39. Five cars with hot boxes were set out but not reported on the recorder.

One road reports a detector was installed in November 1956, but actual records were not kept until April 1, 1957. By October 30, 1958 this instrument recorded 217 hot boxes and 41 false alarms. This road reports that they have not been able to determine the reason for the false alarms. They do know that on one occasion the hot boxes detected on three cars were examined by trainmen and nothing found wrong. However, 40 miles beyond, the same three cars were set out with hot boxes.

Factors to be considered when locating detectors.

1. Locate detector so that once a train with a hot box has passed the detector, an interlocking operator, dispatcher, or other persons can control a wayside signal to indicate to the train crew that they should stop. At that point a telephone or special signal indication should be provided so the train crew can be informed of the hot box.

2. Locate detector approximately 3 to 5 miles in approach to a yard, where the freight train can be inspected by car inspectors located at the yard. Thus the detector will catch, or pinpoint hot boxes for trains inbound to the yard.

3. Locate detector so that when a train is stopped for hot box inspection it is convenient to a siding where the car can be set out if necessary.

4. Experience has indicated that if a journal is going to heat up after standing in a yard, it will usually do so in the first 30 miles of running. Some thinking is that additional installations should be made at intervals thereafter, depending upon the past experience with hot boxes in the territory under consideration.

Action Recommended

Acceptance as information.

ELECTRONIC DEVICE FOR THE DETECTION OF HOT BOXES

An infrared system, called the hot box detective, has been developed for the detection of hot boxes.

This system can discern an abnormal or potentially dangerous journal box of trains moving at speeds of 10 to 60 miles per hour, which cannot be detected by a human observer. Recordings by this system reflect variations in external journal temperatures. An actual hot box gives large-scale deflections usually identifiable from normal boxes.

The system has been field tested on a number of Class I railroads with encouraging results.

The hot box detective is a permanent trackside installation, contained in a cast-iron housing and mounted on a concrete foundation or on movable iron cradles. The detector head is located outside and parallel to the rails with the pyrometer lens aimed at about 35 degrees with respect to the horizontal plane. Major components are accessible and easily replaced.

The system's components are shown in Fig. 1. The wheel flanges of the train pass over a transducer (the magnetic pick-up), disturbing its magnetic field. This causes a voltage to be induced in a coil. The voltage so derived operates a solenoid-operated protective cover of the detective, enabling the infrared pyrometer to scan the passing journal boxes. At the same time, the impulses generated by the magnetic pick-up are employed to gate the signal received by the processing amplifier of the hot box detective, so that primarily only heat impulses from the journal boxes appear on the paper tape of the

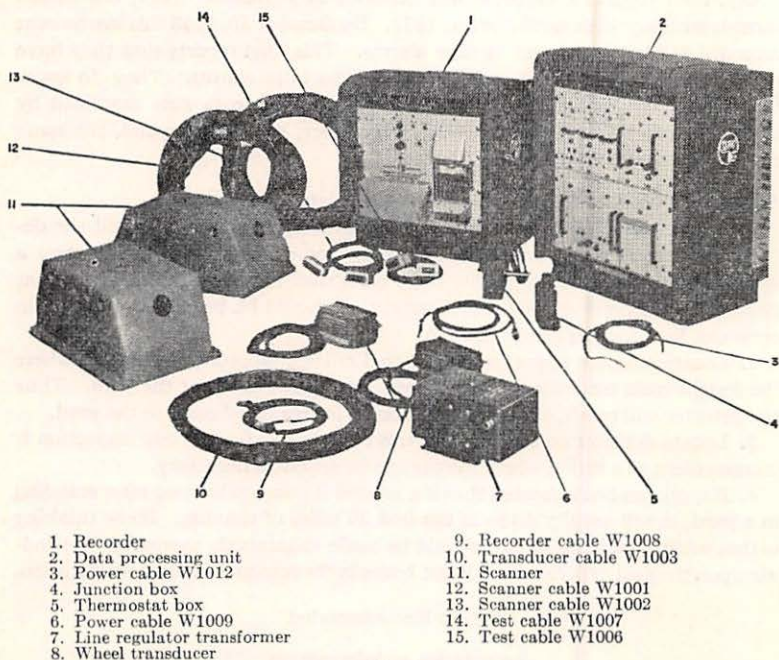


Fig. 1.

stylus pen recorder. The relative amplitudes of the heat impulses are determined by the infrared pyrometer. The resulting recording documents abnormalities and identifies journals in need of attention. When the train has passed, the detective cover slides back into place, protecting the equipment against ambient conditions of dust and dirt during idle periods.

The hot box detective utilizes a highly sensitive thermistor bolometer, which senses heat radiation from the journal housing. This bolometer is the heart of the detective. The cell has a negative coefficient of resistance with temperatures, causing the detective's resistance to decrease with an increase in incoming heat energy. The bolometer assembly contains two thermistor elements in a bridge circuit. Target radiation is focused on one cell by a special lens. The other cell is exposed to ambient conditions only, to keep the bridge balanced under ambient temperature variations. When the target cell is looking at a journal, any unbalance between the two cells results in an output voltage from the bridge, which is amplified, processed and recorded.

The bolometer reacts almost instantaneously to infrared radiation and this fast response and high sensitivity allow the bolometer to operate effectively over a wide range of speeds and temperatures. Its construction and circuit design produce a system virtually unaffected by changes in ambient temperatures.

Different wheel diameters do not affect the operation of the detective, because of the parallel orientation of the pyrometer heads. The problem of lateral movement of the journal housings is minimized by the pyrometer's very small field of view (approximately 1 square inch) which accommodates maximum motion in either direction.

Signal processing amplifiers and power supplies are housed in signal cases convenient to the location of the detective head. A recorded "readout" of the thermal stylus pen type is installed at some manned location. Utilization of modulated carrier current places no limitation on the distance between the detective and the recorder.

The transducer is a magnetic unit which requires no external power source. Electrical signals or impulses are generated by the motion of the train. The wheel pick-up permits the identical area of journal housing to be viewed by the detective, regardless of the train's speed.

This is a development of the Servo Electronic Switch & Signal Co.

Action Recommended

Acceptance as information.

TRANSISTORIZED UNIT CARRIER

Equipment, termed transistorized unit carrier, has been developed to fulfill a need for reliable low-voltage apparatus that operates on carrier frequencies above the normal voice range.

This equipment, shown in Fig 1, features a new and compact package for the individual transmitter and receiver. Each of these has the same mounting base dimensions as the standard PN-150 relay, which are 8 by $2\frac{1}{16}$ inches. The height of each unit is $5\frac{3}{8}$ inches, excluding the top plate terminals. The transmitter weighs 2.5 pounds and the receiver 2.75 pounds. Printed circuits shown in Fig. 2 have been used throughout the design to aid in achieving this compact size. The units may be rack, wall, or shelf-mounted.

Eighteen channels are presently available in single frequencies from 9 kilocycles to 31 kilocycles. The frequency assignment for each channel is identical to the frequency assignments of tube type individual carrier units described on page 209-A, AAR Signal Section 1944 Proceedings, Vol. XLII, and equipment of the same frequency can be used interchangeably except for supply voltage.

Normal battery supply voltage is from 10 to 14 volts with a nominal current drain of 13 milliamperes for the transmitter and, under the energized condition, 30 milliamperes for the receiver. The receivers require approximately 10 milliamperes when they are not receiving a signal. The allowable ambient temperature operating range is from minus 35 to plus 150 degrees Fahrenheit.

The transmitter is designed to transmit a maximum level of +8 dbm into a 600-ohm line and is equipped with a potentiometer adjustment that provides for output adjustment down to whatever minimum level is desired. This adjustment is readily accessible on the top plate of the unit but provision is made for locking the potentiometer adjustment by means of a nut that can be turned with an AAR wrench.

The receiver is designed to receive at a maximum sensitivity of -15 dbm and to deliver 100 milliwatts into a 400-ohm PN-150 relay load. Different relay resistance loads may be used, however, at some small sacrifice in maximum sensitivity. The receiver is also equipped with an accessible potentiometer control equipped with a locking feature for adjustment of sensitivity. The receiver is designed to be used with a 600-ohm line.

The transmitter and receiver possess highly selective output and input filters that employ high quality capacitors and toroidal coils. Thus each unit presents a very high impedance to all frequencies except the one to which it is tuned and can be placed on a line with direct current, alternating current, or other carrier facilities, including other carrier equipment, without interaction or loss due to these units bridging the line.

The transmitter comprises an oscillator that is LC tuned and a stage of amplification that also serves as a buffer in preventing the input impedance of the line from reflecting back and changing the frequency of oscillation. The output of this amplifier is transformer-coupled to the tuned output circuit. The oscillator voltage supply circuit is designed to give frequency stability over wide fluctuations in supply voltage and to keep the output voltage variation relatively small. Protection against induced voltage surges that may appear on the battery supply line is provided in the unit. When a USG shunt lightning arrester is placed externally across the battery supply to the unit, the

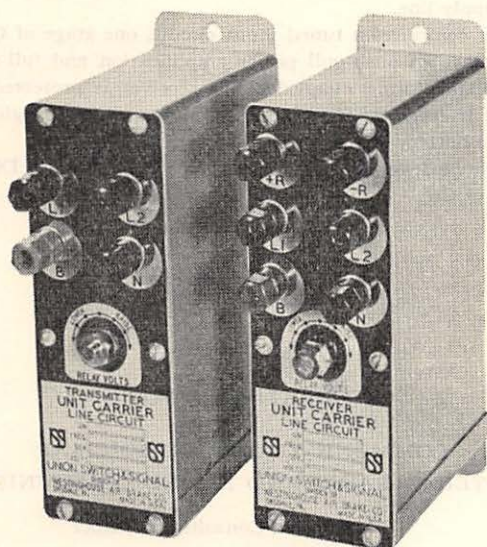


Fig. 1.

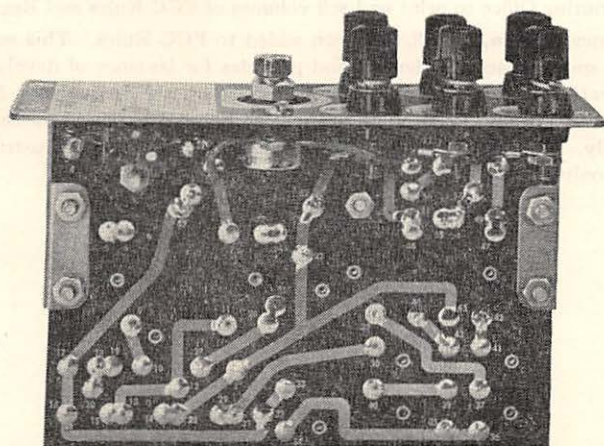


Fig. 2.

combination affords protection against lightning surges that may appear on the battery supply line.

The receiver comprises a tuned input circuit, one stage of Class A amplification, one stage of push-pull power amplification and full-wave rectifier. All stages are transformer-coupled. The receiver is protected in the same manner as the transmitter from induced voltage surges or lightning entering from either the battery supply or the line.

These units are a development of the Union Switch & Signal Div. of Westinghouse Air Brake Co.

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

COMMUNICATIONS SECTION, AAR COMMITTEE 4—RADIO AND ALLIED COMMUNICATIONS*

J. M. Hesser, Consulting Member

The Communications Section, AAR, has issued to its members the following information which may be of interest to signal personnel involved in, or contemplating, the use of radio:

1. The Federal Communications Commission has arranged with the Government Printing Office to print and sell volumes of FCC Rules and Regulations.
2. A new section, 16.358, has been added to FCC Rules. This section relates to speed measuring devices and provides for issuance of developmental authorizations in the Railroad Radio Service on the frequencies 2455 and 10525 mc. for Radio Positioning Stations to be used by speed measuring devices only. Such authorizations were formerly issued in the Industrial Radio Service only.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in AAR Signal Section 1956 Proceedings, Vol. LIV, pp. 193 and 266.

COMMITTEE XII—CIRCUIT DESIGN

Personnel

T. L. Carlson, Chairman

R. E. Testerman, Vice-Chairman

P. A. Brady	H. L. Hinton
R. A. Bristol	E. F. Koester
B. E. Brooksby	H. L. Kruke
B. R. Dellinger	D. L. Luigs
J. F. Derochi	L. W. Matson
R. C. Foster	A. O. Schwartz
A. N. Goodson	L. A. Sebeczek
D. W. Greaves	D. H. Steiner
H. M. Hesser	G. O. Ferm*

D. D. Huffman*

Signal Section, AAR:

The following outline of work has been assigned:

1. Report to the Signal Section Research Committee any projects considered proper for submission to the AAR Research Center.

2. Prepare typical circuits representing current practice for railway signaling, as follows:

(a) Automatic block signals and traffic control systems.

1. For track equipped for operation in one direction only.

- (a) Color light type signals, conventional d.c. track circuits.
- (b) Searchlight type signals, conventional d.c. track circuits.
- (c) Coded track circuits with and without use of line wires.
- (d) Electric switch locking.
- (e) Spring switch protection.
- (f) Approach and advance lighting.
- (g) Light-out protection.

2. For track equipped for operation in both directions.

- (a) Color light type signals, conventional d.c. track circuits.
- (b) Searchlight type signals, conventional d.c. track circuits.
- (c) Coded track circuits.
- (d) Electric switch locking.
- (e) Spring switch protection.
- (f) Approach and advance lighting.
- (g) Light-out protection.

(b) Interlocking.

1. Relay type interlocking, unit and route types.

- (a) Route-check network (lever-agreement relays).
- (b) Signal control network.
 - 1. Color light type signals.
 - 2. Searchlight type signals.
- (c) Signal indication.
- (d) Time locking.

* Consulting Member.

- (b) Interlocking.—Continued.
 - (e) Approach locking.
 - (f) Route locking.
 - (g) Switch locking.
 - (h) Switch control.
 - (i) Switch indication.
 - (j) Power distribution.
 - (k) Model board indications.
 - (l) Remote control circuits.
 - (m) Electric locking of hand-operated switches within interlocking limits.
 - (n) Traffic locking.
 - (o) Movable bridge protection.
- 2. Automatic interlocking.
- (c) Highway crossing signal protection.
 - 1. Control arrangement.
 - (a) Selective speed controls.
 - (b) Timing-out and cut-out circuits.
 - (c) Interconnection with street traffic signal devices.
 - 2. Types of protection.
 - (a) Flashing lights.
 - (b) Automatic and semi-automatic gates.
- (d) Wayside typical circuits for train stop, train control, and cab signals.
 - 1. Continuous.
 - 2. Intermittent.
- (e) Classification yard signal systems.
 - 1. Hump, repeater, trimmer and switch signal circuits.
 - (a) Color light.
 - (b) Searchlight.
 - 2. Switch control circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 3. Retarder circuits.
 - (a) Electro-pneumatic.
 - (b) Electric.
 - 4. Special circuits.
- (f) Miscellaneous.
 - 1. Power and color light train order signals.
 - 2. Lightning protection.
 - 3. OSing devices.
 - 4. Control and indication circuits using electronic devices.

3. Investigate and report on the feasibility of a standard covering size, format, sheet sizes, placing of title blocks, revision blocks, print folds and other format elements in the preparation of signal plans.

The committee submits for consideration, reports on the following subjects*:

- 2. AAR Sig. Sec. 8052B, 8080B and 8086A.

* Suggestions or criticisms should be submitted in writing to the chairman of the committee on or before September 1, 1959.

TYPICAL CIRCUITS REPRESENTING CURRENT PRACTICE
FOR RAILWAY SIGNALING*

The committee presents herein, seven revised and new sheets of typical circuit plans representing current practice for railway signaling. These plans are designed to meet current signal problems, but should not be considered as working drawings. It should be understood that they are typical plans, and in applying them to a specific situation, consideration must be given to the type of equipment employed and to local conditions.

The plans presented are:

AAR
SIG. SEC.

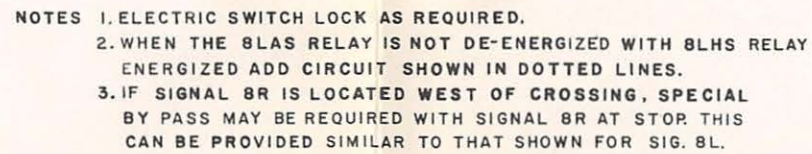
- 8052B (Sheets 1 and 2)—Control Circuits for Automatic Highway Grade Crossing Signals. These circuits illustrate timing cut-outs varying the length of the crossing signal approach in accordance with the speed of approaching train. Sheet 1 is a revision of plan presented in 1950; Sheet 2 is new.
- 8080B (Sheets 1, 2 and 3)—Circuits for Automatic Signal Protection of Movable Bridge—Track Signaled for Movement in Both Directions. These plans show circuits for movable bridge in automatic signal or traffic control territories. The signal circuits provide all necessary protection over the bridge and are a part of signaling system routing from siding to siding when bridge control lever is positioned for railroad traffic. These circuits were presented at the 1957 Annual Meeting but were withdrawn for revision. They have been revised per discussion on the floor of that meeting.
- 8086A (Sheets 1 and 2)—Circuits for Automatic Control of Signals and Switches—For Single Track Operation between Adjacent Ends of Double Track. These circuits provide signaling for operation on a section of single track such as over a bridge or through a tunnel in double track territory.

Action Recommended

Acceptance as information.

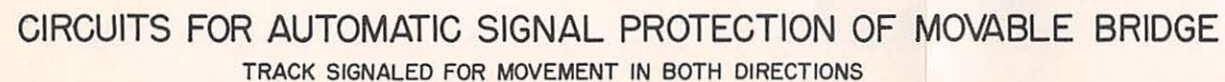
*Previous report on this subject appears in AAR Signal Section 1957 Proceedings, Vol. LV, pp. 233-A and 261-A.

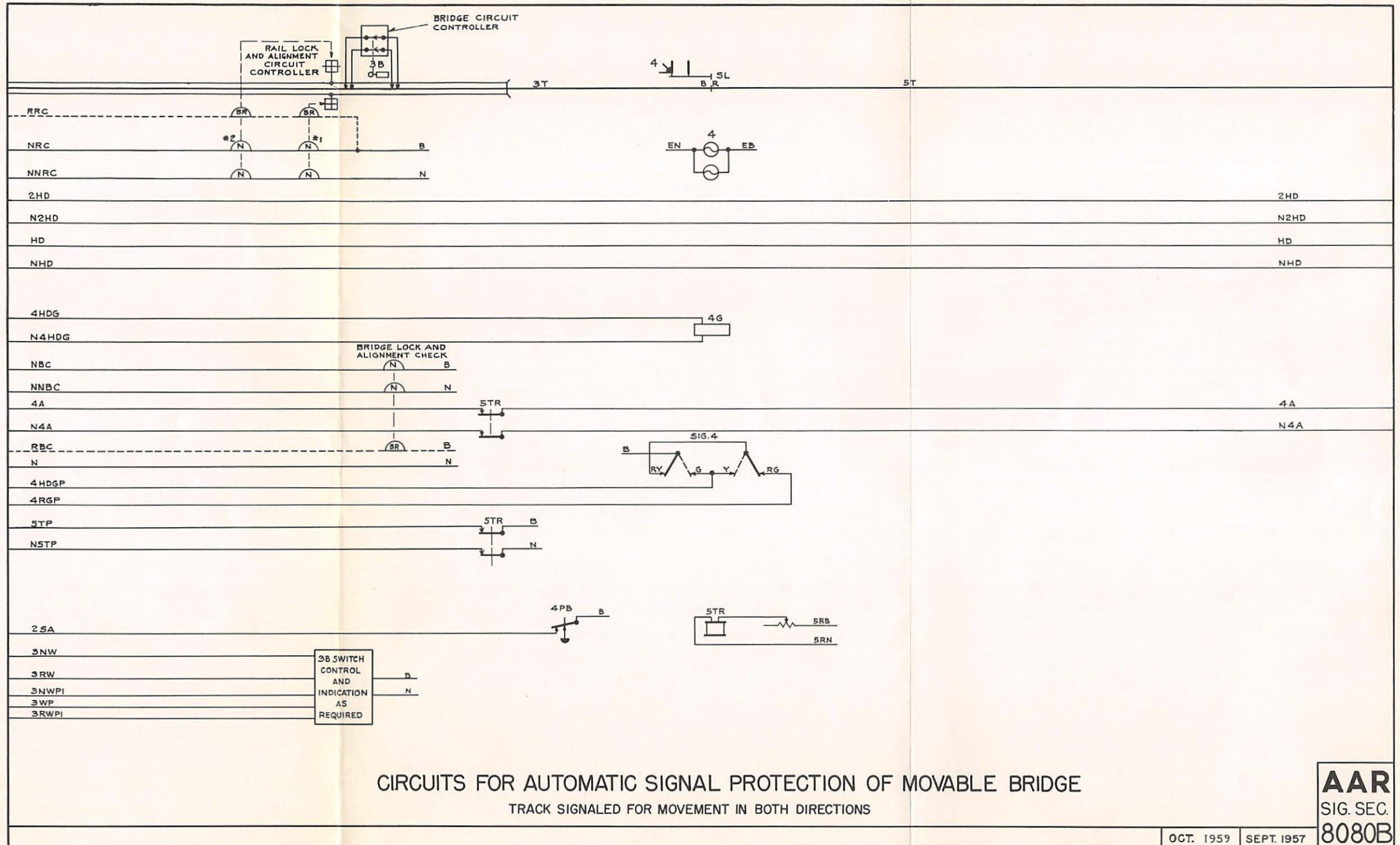




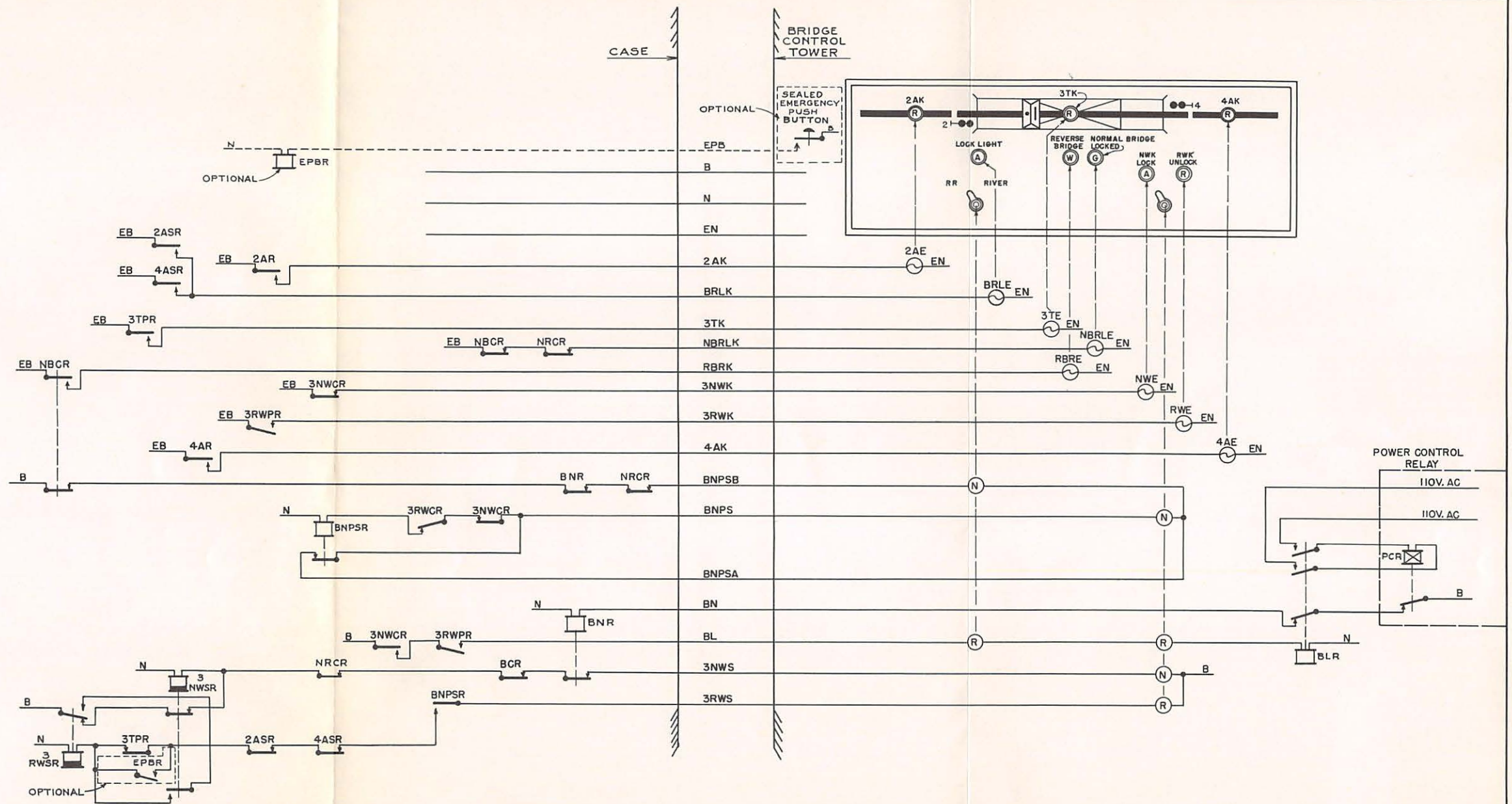
CONTROL CIRCUITS FOR AUTOMATIC HIGHWAY GRADE CROSSING SIGNALS

ILLUSTRATING MAXIMUM, INTERMEDIATE, AND LOW SPEED STARTS WITH TIME AND SPECIAL CUTOUTS

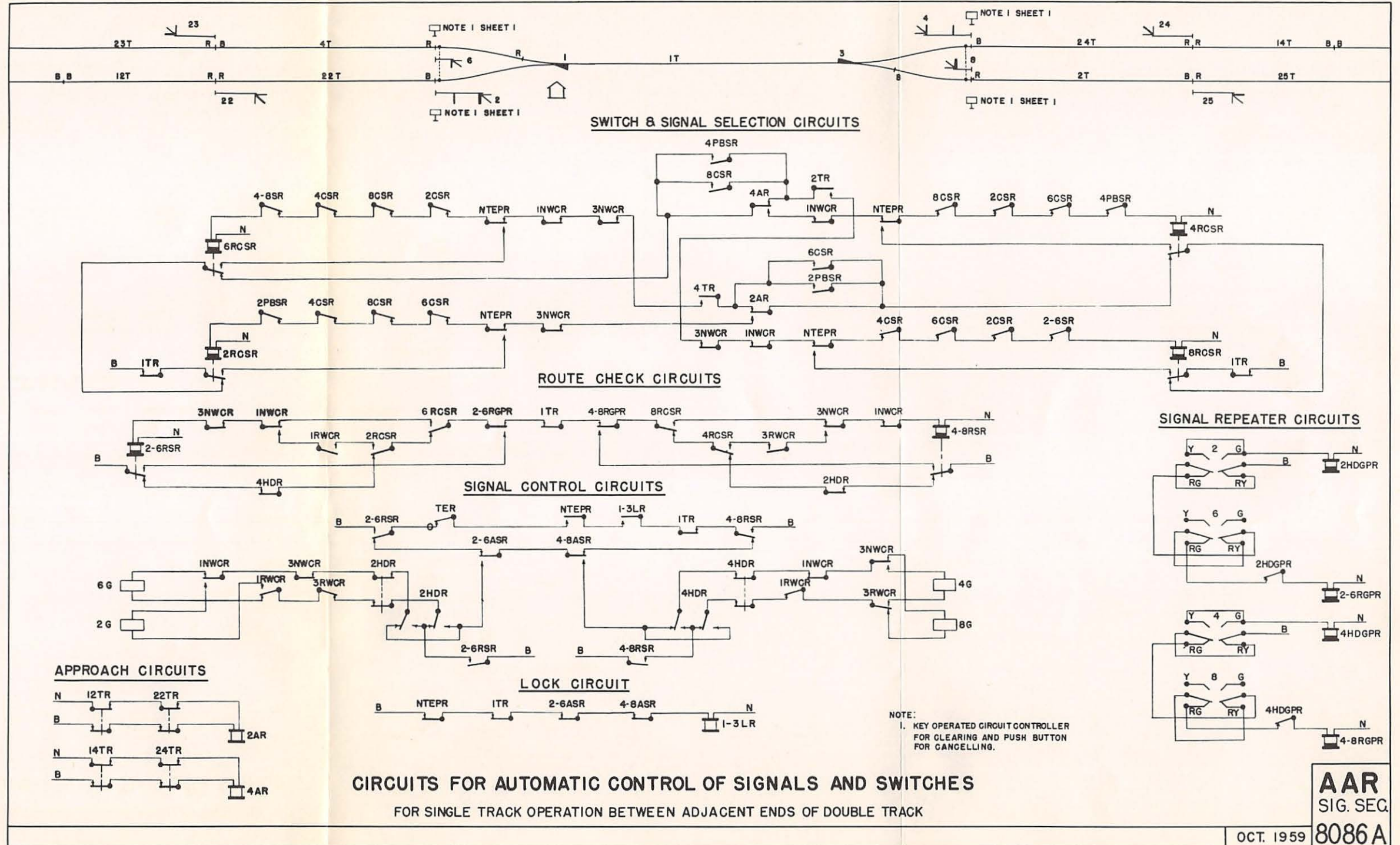




CIRCUITS FOR AUTOMATIC SIGNAL PROTECTION OF MOVABLE BRIDGE
TRACK SIGNALLED FOR MOVEMENT IN BOTH DIRECTIONS



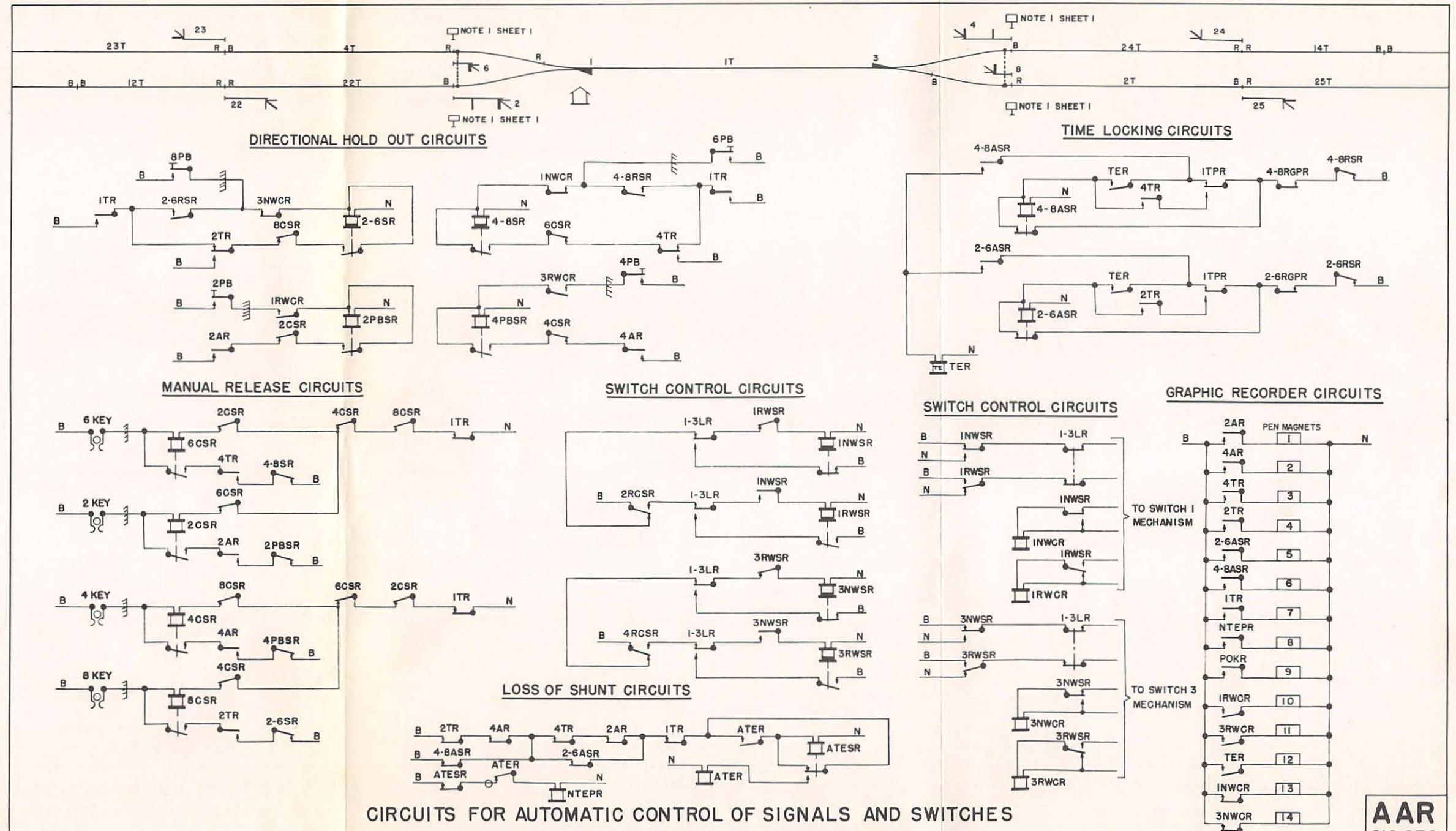
CIRCUITS FOR AUTOMATIC SIGNAL PROTECTION OF MOVABLE BRIDGE
 TRACK SIGNALLED FOR MOVEMENT IN BOTH DIRECTIONS



OCT. 1959

AAR
SIG. SEC.
8086A

SHEET 1



RULES OF ORDER

Effective April 6, 1938

Revised Dec. 6, 1938; May 22, 1940; Mar. 12, 1941; May 17, 1944; Dec. 11, 1946; June 8, 1949; May 7, 1952; Feb. 16, 1954; Feb. 15, 1955; Oct. 10, 1955; May 14, 1957; Dec. 2, 1958.

1. **REPRESENTATIVES:** The representatives of Member Roads in the Signal Section shall be employees engaged in an official or supervisory capacity in the design, construction or maintenance of railroad signaling devices. Included within this category shall be Signal Superintendents, Signal Engineers and their Assistants, Signal Inspectors, Chief Draftsmen, Signal Supervisors and Assistant Signal Supervisors, or others with corresponding duties.
2. **AFFILIATED MEMBERS:**
 - (a) **RAILROAD AFFILIATED MEMBERS:** A member of a State or Federal regulatory body, or a railroad employee not embraced within the provisions of paragraph 1 (including those temporarily relieved from service or furloughed) may become a **RAILROAD AFFILIATED MEMBER** upon approval of his application by the Committee of Direction. Such a member will pay an annual fee of \$5.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (b) **AFFILIATED MEMBERS:** A representative of an organization or an individual engaged in the design, manufacture, sale or construction of signal devices or materials applicable thereto, or one who is qualified by his business relations and practical experience to cooperate with the Section, may become an **AFFILIATED MEMBER** thereof upon approval of his application by the Committee of Direction. An Affiliated Member will pay an annual fee of \$10.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (c) A Railroad Affiliated or an Affiliated Member shall have the rights and privileges accorded a Member Road representative except voting or the holding of office.
 - (d) A Railroad Affiliated or an Affiliated Member may be appointed as a Consulting Member of any Standing Committee upon the approval of the Committee of Direction.
3. **LIFE MEMBERS:** Life membership may be conferred upon members who retire from active work. They shall have been active in the affairs of the Signal Section and its predecessors and their total term of membership shall have been not less than twenty-five years. A proposal to confer Life Membership must be signed by five voting representatives of Member Roads and five representatives of Member Roads, stating their reason for

making such proposal. Proposal shall be duly considered at a meeting of the Committee of Direction and then submitted to a vote by letter to the Committee of Direction membership for approval.

Officers and Committees

4. The Officers of the Section shall consist of a Chairman, First Vice-Chairman, Second Vice-Chairman, and Secretary.

- (a) The Chairman and Vice-Chairmen shall be selected by the Committee of Direction on or before November 1st. Their terms of office shall be one year from January 1st or until their successors are selected and qualified. A Chairman or Vice-Chairman having served a full term shall not succeed himself.
- (b) The Secretary will be appointed by the Committee of Direction. His salary shall be named by that Committee subject to the approval of the Vice-President, Operations and Maintenance Department of the Association.
- (c) The COMMITTEE OF DIRECTION will consist of twelve members, as follows: The Chairman, the First Vice-Chairman, the Second Vice-Chairman, the latest Past Chairman, one member from New England or Canada, three members from the East, one member from the South and three members from the West.

The territorial representatives, except when filling vacancies, shall serve four years and their term of office will expire on December 31st of the fourth year.

Vacancies in official positions or of territorial representatives shall be filled until the next election, by the Committee of Direction.

One Vice-Chairman shall be selected from Eastern Territory and one from Western Territory. For this purpose the Eastern Territory will consist of all territory operating under Eastern and Atlantic Standard Time. All other territory will be known as Western Territory. The location of the official's headquarters will determine whether he is in the Eastern or Western territory.

- (d) The Standing Committees of the Section will be as follows:

- I—Economics of Railway Signaling
- II—Controlled Signaling and Interlockings
- III—Signal Shop Practice
- IV—Automatic Block Signaling
- V—Contracts and Instructions
- VI—Designs
- VII—Materials Research
- VIII—Highway Grade Crossing Protection
- IX—Wire and Cable
- X—Signaling Practice
- XI—Electronics
- XII—Circuit Design

The representation of Member Roads on these committees will be, when practicable, territorially selected, in approximately the same proportion as that of the Committee of Direction, the personnel to be named each year by the Committee of Direction.

Duties of Officers

5. The CHAIRMAN shall have general supervision over the affairs of the Section and shall preside at meetings of the Section and at meetings of the Committee of Direction.
6. The FIRST VICE-CHAIRMAN, in the absence of the Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
7. The SECOND VICE-CHAIRMAN, in the absence of both the Chairman and First Vice-Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
8. (a) The SECRETARY shall devote his entire time to the work of the Section and will perform the usual duties of that office and such other duties as may be assigned to him by the Chairman.
(b) He shall receive on or before November 20th of each year the report of the Committee on Nominations, as elsewhere provided for, and will submit to the voting representatives of Member Roads, not later than November 29th, for letter ballot vote, the nominations contained in that report, to fill the vacancies in the membership of the Committee of Direction. He shall appoint three Tellers from representatives of Member Roads to assist him in counting the ballots, who shall certify the count thereof, with him, to the Committee of Direction. He shall announce the result of the ballot to the Members promptly.
(c) He shall furnish, free of charge, to each representative of a Member Road, designated by such road, one copy of all circulars, Advance Notices and Minutes.
(d) He shall furnish to each Railroad Affiliated, Affiliated and Life Member one copy of all circulars, Advance Notices and Minutes.

Duties of Committees

9. The COMMITTEE OF DIRECTION shall:
 - (a) Exercise general supervision over the interests and affairs of the Section.
 - (b) Be empowered to act on behalf of the Section in the interim between meetings and submit at each meeting a report covering its actions.
 - (c) Examine and decide what portion of communications, papers and reports shall be submitted to the meetings. It shall determine which, if any, of the subjects presented by the various committees shall be referred to the General Committee of the Engineering Division.
 - (d) Appoint on or before October 1st of each year a Committee on Nominations consisting of representatives of five Member Roads, who shall not be members of the Committee of Direction.
 - (e) Appoint additional committees as required.

- (f) Submit to the Vice-President, Operations and Maintenance Department, detail of contemplated financial requirements for conducting the work of the Section as required or as called for by that official.
 - (g) Call Annual meetings of the Section if in its judgment conditions warrant.
 - (h) Call meetings of the Section upon not less than thirty days' notice to each member. It **MUST** call a special meeting of the Section upon the request in writing of a majority of the voting members of Member Roads.
 - (i) Publish Manual of Recommended Practice, in which shall be included such approved Specifications, Drawings, Findings and Conclusions of the Section as the Committee of Direction may find advisable.
10. The COMMITTEE ON NOMINATIONS, appointed as prescribed above, shall report to the Secretary on or before November 20th each year at least two nominations for each impending vacancy to replace the territorial representatives on the Committee of Direction.
- The duties of the Standing Committees shall be as follows:
- 11. COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING. Study and report on the economy, if any, of the various signal systems, interlocking, train control, cab signals and other signaling projects.
 - 12. COMMITTEE II—CONTROLLED SIGNALING AND INTERLOCKINGS. Prepare specifications for the various types of controlled signaling and interlockings and submit reports on subject-matters relating thereto.
 - 13. COMMITTEE III—SIGNAL SHOP PRACTICE. Study and report on signal shop practices.
 - 14. COMMITTEE IV—AUTOMATIC BLOCK SIGNALING. Prepare specifications for the various types of automatic block systems and submit reports on subject-matters relating thereto.
 - 15. COMMITTEE V—CONTRACTS AND INSTRUCTIONS. Prepare recommended forms for use in connection with signaling contracts and prepare instructions relating to signal maintenance.
 - 16. COMMITTEE VI—DESIGNS. Prepare detailed drawings for standardization purposes and make any special study or investigation assigned to it by the Committee of Direction.
 - 17. COMMITTEE VII—MATERIALS RESEARCH. Make such investigation of materials used in connection with signaling as directed by the Committee of Direction and submit reports on its conclusions.
 - 18. COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION. Prepare requisites for highway grade crossing protection and submit matters of interest relating thereto.

Oct. 1959]

19. COMMITTEE IX—WIRE AND CABLE. Prepare specifications for wire and cable, overhead and underground lines and any recommendations relating thereto which will be of interest to the Section.
20. COMMITTEE X—SIGNALING PRACTICE. Prepare requisites for the various types of interlocking and block signaling systems, make recommendations having reference to the signal indications which should be given as the varied conditions on railroads require, also submit reports on such other matters as may be assigned by the Committee of Direction.
21. COMMITTEE XI—ELECTRONICS. Investigate and report on the use of electronics in connection with railway signal systems, interlocking, centralized traffic control, and highway grade crossing protection.
22. COMMITTEE XII—CIRCUIT DESIGN. Prepare typical circuits representative of approved practices and requisites for railroad signaling.
23. REPRESENTATION OF THE SECTION UPON GENERAL COMMITTEE OF THE ENGINEERING DIVISION: The five representatives of the Signal Section upon the General Committee of the Engineering Division shall be the Chairman, First Vice-Chairman, Second Vice-Chairman, and two members of the Committee of Direction to be selected by it.
24. RECOMMENDED PRACTICES:

Any definition, nomenclature, specification, recommended construction or recommended practice or any proposition having for its objective the formal declaration of the Section upon any matter of importance shall be presented in writing (accompanied by drawings if the latter are necessary for a clear understanding of the subject).

Such submissions will be presented to the Section at its Annual meeting for discussion, and following vote to decide whether or not the proposition shall be submitted to the voting members of Member Roads for adoption or rejection by letter ballot. If the vote to submit is affirmative, the Secretary within three months from the date of the meeting will distribute the ballots with a copy of the Minutes of the meeting, requesting their return within thirty days, naming the date. Ballots mailed after that date, as shown by the postmark, will not be counted. The Secretary shall announce the result of the ballot promptly to the Members. Ballots and envelopes shall be preserved for at least two years from date of announcement. The voting power of the Member Roads shall be as named in paragraph 26.

25. VOTING AT MEETINGS OF SECTION: Vote may be taken viva voce, by rising, by roll call or by ballot. Each Member Road shall be entitled to one vote, the ranking officer of a road present at any meeting being recognized as the voting representative of that road, unless otherwise designated by it. The vote of a majority of the Member Roads represented shall be required to decide any question, motion or resolution unless otherwise ordered, except that in the consideration of submitting a question to the letter ballot vote of the Member Roads, all representatives of Member Roads present at any meeting may vote. Thirty representatives of Member Roads shall constitute a quorum.

26. LETTER BALLOTS:

Letter ballots may be taken upon any subject by order of the Committee of Direction and *must* be taken on all questions affecting physical property. Each Member Road shall have one vote plus one vote for each 2,000 units of signal equipment owned according to the current Table of Signal and Interlocking Units, Manual Part 203. If, after dividing the total units by 2,000, the remainder exceeds 1,000 units it shall be counted as one vote.

Any proposition for which a majority of the votes are affirmative, shall be considered adopted.

27. ORDER OF BUSINESS: The order of business at meetings of the Section shall, unless otherwise directed by a majority of the members present, be as follows:

- Approval of Minutes of Last Meeting;
- Reports of Standing Committees;
- Reports of Special Committees;
- Unfinished Business;
- New Business.

28. Roberts' Rules of Order shall govern the proceedings of the Section, including amendment of these Rules of Order.

RESULT OF LETTER BALLOT ON SUBJECTS APPROVED AT THE
ANNUAL MEETING, SEPTEMBER 16, 17 AND 18, 1958

All subjects have received the required affirmative letter ballot vote, as follows:

	For	Against
<i>Committee II—Controlled Signaling and Interlockings</i>		
Requisites for Switch Operating Mechanism for Slow Speed Train Movements. (New.).....	1,645	0
Specification 128-58—Mechanical Time Release. (Superseding Specification 128-49, Manual Part 129.).....	1,645	0
Specification 245-58—Classification Yard Control Machines. (Superseding Specification 245-54, Manual Part 251.).....	1,645	0
<i>Committee IV—Automatic Block Signaling</i>		
Specification 151-58—Plug Type Rail Web Bonds and Track Circuit Connectors. (Superseding Specification 151-50, Manual Part 112.).....	1,645	0
AAR Sig. Sec. 1631F—Single Conductor Plug Type Rail Bonds and Track Circuit Connectors. (Superseding AAR Sig. Sec. 1631E in the Manual.).....	1,645	0
AAR Sig. Sec. 1632F—Duplex Conductor Plug Type Rail Bonds and Track Circuit Connectors. (Superseding AAR Sig. Sec. 1632E in the Manual.).....	1,645	0
Specification 83-58—Transformer, Dry-Type, Self-Cooled. (Superseding section 7 of Specification 83-52, Manual Part 164.).....	1,645	0
Specification 84-58—Transformer, Oil-Immersed, Self-Cooled. (Superseding section 7 of Specification 84-53, Manual Part 165.).....	1,645	0
<i>Committee V—Contracts and Instructions</i>		
Instructions for Impedance Bonds. (New.).....	1,645	0
Instructions for Insulation Resistance Testing. (Superseding Instructions for Insulation Resistance, Manual Part 130.).....	1,645	0
Instructions for Light and Semaphore Signals. (Superseding Instructions for Light and Semaphore Signals, Manual Part 54.).....	1,645	0
<i>Committee VI—Designs</i>		
AAR Sig. Sec. 1491F—Highway Crossing Gate Roadway Arm for Mast Mounted Gate Mechanism. (Superseding AAR Sig. Sec. 1491E in the Manual.).....	1,645	0
AAR Sig. Sec. 1492C—Highway Crossing Gate Sidewalk Arm for Mast Mounted Gate Mechanism. (Superseding AAR Sig. Sec. 1492B in the Manual.).....	1,645	0

For Against

Committee VI—Designs—Continued

AAR Sig. Sec. 1493B—Highway Crossing Gate Roadway Arm for Pedestal Mounting. (Superseding AAR Sig. Sec. 1493A in the Manual.)	1,645	0
AAR Sig. Sec. 1494B—Highway Crossing Gate Sidewalk Arm for Pedestal Mounting. (Superseding AAR Sig. Sec. 1494A in the Manual.)	1,645	0
AAR Sig. Sec. 1505C—Falling Rock Detector—Details and Assembly. (Superseding AAR Sig. Sec. 1505B in the Manual.)	1,645	0
AAR Sig. Sec. 1506B—Rock Slide Detector—Details and Assembly. (Superseding AAR Sig. Sec. 1506A in the Manual.)	1,645	0
AAR Sig. Sec. 1634C—Insulated Joint Location—Automatic Signals and Interlocking. (Superseding AAR Sig. Sec. 1634B in the Manual.)	1,645	0
Drawing 1176—Trunking—Grooved Type. (To be removed from the Manual.)	1,645	0
Drawing 1177—Trunking—Built-Up Type. (To be removed from the Manual.)	1,645	0
RSA 1232—Mechanical Dwarf Signal Top and Base Bearings (Details). (To be removed from the Manual.)	1,645	0
AAR Sig. Sec. 1233B—Mechanical Dwarf Signal Spectacles and Lamp Bracket Support—Details and Assembly. (To be removed from the Manual.)	1,645	0
AAR Sig. Sec. 1239B—Mechanical Dwarf Signal Fittings—Details. (To be removed from the Manual.)	1,645	0
AAR Sig. Sec. 1567B—Mechanical Dwarf Signal—Details. (To be removed from the Manual.)	1,645	0
ARA Sig. Sec. 1568A—Mechanical Dwarf Signal—Details. (To be removed from the Manual.)	1,645	0
AAR Sig. Sec. 1270A—Insulated Rod for Switch Circuit Controller—Details and Assembly. (New.)	1,645	0
AAR Sig. Sec. 1290A—Begin TCS Sign—End TCS Sign—Sheet Metal Type for 4 to 8-Inch Pipe—Details and Assembly. (New.)	1,645	0
AAR Sig. Sec. 1330A—Switch Obstruction Gages—Details and Assembly. (New.)	1,645	0
AAR Sig. Sec. 1520A—Steel Battery Box—Small Size—Assembly. (New.)	1,604	41
AAR Sig. Sec. 1521A—Steel Battery Box—Small Size—Details. (New.)	1,604	41
AAR Sig. Sec. 1522A—Steel Battery Box—Large Size—Assembly. (New.)	1,604	41
AAR Sig. Sec. 1523A—Steel Battery Box—Large Size—Details. (New.)	1,604	41

For Against

Committee VI Designs—Continued

AAR Sig. Sec. 1524A—Steel Battery Box—Details and Assemblies. (New.).....	1,604	41
AAR Sig. Sec. 1525A—Steel Battery Box—Details. (New.)....	1,604	41
AAR Sig. Sec. 1526A—Steel Battery Box—Details. (New.)....	1,604	41
AAR Sig. Sec. 1527A—Steel Battery Box—Details and Assemblies. (New.).....	1,604	41
AAR Sig. Sec. 1560A—Precast Concrete Foundation for 5 and 6-Inch Masts—Details. (New.).....	1,645	0
AAR Sig. Sec. 1561A—Precast Concrete Foundation for 8-Inch Mast—Details. (New.).....	1,645	0
AAR Sig. Sec. 1579A—Precast Concrete Foundation for 10 and 12-Inch Masts—Details. (New.).....	1,645	0
AAR Sig. Sec. 1580A—Precast Concrete Foundations—Assemblies. (New.).....	1,645	0
AAR Sig. Sec. 1723A—Articulated Highway Crossing Gate Arm—Assembly. (New.).....	1,645	0
AAR Sig. Sec. 1724A—Articulated Highway Crossing Gate Arm—Details. (New.).....	1,645	0
AAR Sig. Sec. 1725A—Articulated Highway Crossing Gate Arm—Details. (New.).....	1,645	0
Specification 51-58—Incandescent Electric Lamps. (Superseding Appendix A of Specification 51-57, Manual Part 91.).....	1,645	0
Specification 137-39—Oil Lighted Lamp. (To be removed from the Manual—Manual Part 204.).....	1,645	0

Committee VII—Materials Research

Specification 188-58—Cold Application Sealing Compound. (Superseding Specification 188-40, Manual Part 72.).....	1,645	0
Specification 184-58—Fusible Asphaltic Base Sealing Compound. (Superseding Specification 184-40, Manual Part 73.).....	1,645	0

Committee VIII—Highway Grade Crossing Protection

AAR Sig. Sec. 1734A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic. (New.).....	1,620	25
AAR Sig. Sec. 1735A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic. (New.).....	1,620	25
AAR Sig. Sec. 1736A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—One-Way Vehicular Traffic. (New.).....	1,620	25

For Against

Committee VIII—Highway Grade Crossing Protection—Continued

AAR Sig. Sec. 1737A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway. (New.).....	1,620	25
AAR Sig. Sec. 1738A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway. (New.).....	1,620	25
AAR Sig. Sec. 1739A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway. (New.).....	1,620	25
AAR Sig. Sec. 1740A—Typical Location Plan for Automatic Flashing Light Signals With or Without Gates—Divided Highway. (New.).....	1,620	25
AAR Sig. Sec. 1741A—Typical Location Plan (Composite) for Automobile Flashing Light Signals With Gates—Acute Angle—Divided Highway. (New.).....	1,620	25
AAR Sig. Sec. 1742A—Typical Location Plan (Composite) for Automatic Flashing Light Signals With Gates—Obtuse Angle—Divided Highway. (New.).....	1,620	25
Requisites for Control of Automatic Highway Grade Crossing Signals and Devices. (Superseding Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part 274.).....	1,645	0

Committee IX—Wire and Cable

Specification 89-58—Braid-Covered Cable. (Superseding Specification 89-52, Manual Part 25.).....	1,645	0
Specification 240-58—Neoprene Sheathed Cable. (Superseding Specification 240-52, Manual Part 249.).....	1,645	0
Instructions for Wiring. (Superseding Specification 119-42, Manual Part 84.).....	1,645	0

Committee X—Signaling Practice

Requisites for Protection for Spring Switches. (Superseding Requisites for Protection for Spring Switches, Manual Part 10.).....	1,619	25
Signaling for Gravity Classification Yards. (Superseding Signaling for Gravity Classification Yards, Manual Part 42.).....	1,644	0

CONTENTS

(Continued from inside front cover)

	Page
COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION	153
Disposition of 1958 Letter Ballot Subjects.....	154
AAR Sig. Sec. 1730B—Typical Location Plan for Automatic Gates and Flashing Light Signals—Right Angle Crossing.....	155, 156
AAR Sig. Sec. 1731B—Typical Location Plan for Automatic Gates and Flashing Light Signals—Acute Angle Crossing.....	155, 157
AAR Sig. Sec. 1732B—Typical Location Plan for Automatic Gates and Flashing Light Signals—Obtuse Angle Crossing.....	155, 158
AAR Sig. Sec. 1733B—Typical Location Plan for Automatic Gates and Flashing Light Signals—Curb and Gutter Location.....	155, 159
Highway Grade Crossing Protection Signals and Signs and Their Observance by Highway Users.....	160
COMMITTEE IX—WIRE AND CABLE	161
Disposition of 1958 Letter Ballot Subjects.....	161
Specification 90-59—Lead Sheathed Cable, Submarine.....	162
Specification 168-59—Line Wire.....	169
Instructions for Splices in Insulated Wires and Cables.....	175
COMMITTEE X—SIGNALING PRACTICE	180
Disposition of 1958 Letter Ballot Subjects.....	180
Noteworthy Changes in Signal Methods and Practices.....	181
New and Improved Signal Devices and Related Appliances.....	186
COMMITTEE XI—ELECTRONICS	193
Joint Use of Line Wires for Communications and Signals.....	195
Electronic Registry Unit.....	198
Unijunction Transistor.....	200
Frequency-Shift Transistorized Equipment.....	203
Audio Frequency Overlay Equipment for Highway Crossing Application.....	206
Frequency-Shift Carrier Applied to Traffic Controls and Indications.....	210
Application of Electronic Devices for the Detection of Hot Boxes.....	211
Electronic Device for the Detection of Hot Boxes.....	212
Transistorized Unit Carrier.....	214
Cooperative Report—Communications Section, AAR Committee 4—Radio and Allied Communications.....	216
COMMITTEE XII—CIRCUIT DESIGN	217
Typical Circuits Representing Current Practice for Railway Signaling.....	219
RULES OF ORDER	221
RESULT OF 1958 LETTER BALLOT	227

SIGNAL SECTION, AAR

ADVANCE NOTICE

October 12, 13 and 14, 1959